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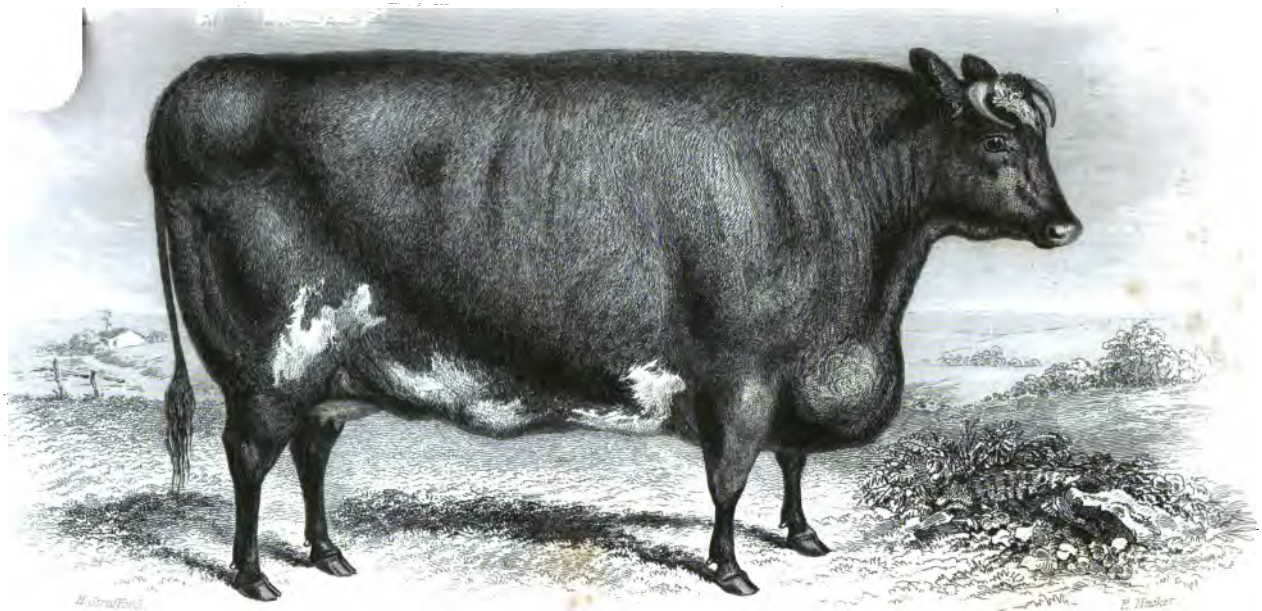

"Necklace" a Short Horned Cow.

THE

MODERN DAIRY

AND

COWKEEPER.

BY

CUTHBERT W. JOHNSON, ESQ., F.R.S.

LONDON:
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PREFACE.

I HAVE so often had occasion to feel grateful for the kind consideration of the English Farmers and Housekeepers, that I am well assured they will extend to this attempt to collect together in a small compass the improved practices of modern Dairies more indulgence than its merits deserve.

Waldronfield, Jan., 1850.

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THE

ENGRAVINGS IN THIS WORK

ARE PORTRAITS OF

1. NECKLACE, a shorthorn cow, bred by J. Booth, Esq., of Killerby, winner of the first prize and the Gold Medal at the Smithfield Show, December, 1846 } To face title page

2. EXQUISITE, a shorthorned bull, bred by the late Earl Spencer, purchased at the Wiseton sale, in 1846, for 370 guineas, by Mr. J. Booth, of Killerby; Mr. R. Booth, of Warlaby; and Mr. W. Torr, of Riby ..... } To face page 14

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4. A DEVON BULL, the property of Mr. James Quartley, of Molland, obtained the first prize of £40 at the meeting of the Royal Agricultural Societyat Norwich, in 1849 ..... } To face page 10

For these Engravings the work is indebted to the kindness and liberality of the Proprietors of the *Farmer's Magazine.*

THE MODERN DAIRY.

In a work like this, intended, amongst other objects, for the use of the cowkeeper, who holds only a small portion of land, the young beginner must not expect full and complete answers to all his inquiries. The keepers of cows are placed under so many different circumstances that he must, after all, use his own good sense in the application of the various facts and suggestions which this little work contains. His soil may be heavy, sandy, or chalky—may be pasture, or land totally unfitted for permanent grass. The food he can procure for his cow may be green food—such as grass, or clover, or roots; in other places he may have ready access to grains; in others he must rely during the larger portion of the year on hay, or malt coombs, or other dry food. In one situation he may have a pasture for the free range or the tethering of his cow; in another, only space for an airy yard and cow-house; in another, he may have only space for the latter.

Amid, however, all these varying circumstances, there are certain good principles in the economical and profitable keeping of a cow which serve in all situations, and it is these to which I propose chiefly to direct my attention in the following pages: They may perhaps be all summed up in a few lines: these are—1, a good breed; 2, regular and good feeding, with clean good water; 3, cleanliness; 4, warmth; 5, quiet.

THE COW.

I need hardly say anything here in commendation of the fine and gentle animal, whose treatment and invaluable produce form the subject of these pages; her value, her services, have been known to mankind from the earliest ages. As I had occasion to remark in another place (*Farmer's Encyclopædia*)—That the ox has been domesticated, and in the service of man from a very remote period, is quite certain. We learn from *Gen.* (iv. 20.) that cattle were kept by the early descendants of Adam. Preserved by Noah from the flood waters, the original breed of our present oxen must have been in the neighbourhood of Mount Ararat; and from thence, dispersing over the face of the globe, altering by climate, by food, and by cultivation, originated the various breeds of modern ages. That the value of

the ox tribe has been in all ages and climates highly appreciated, we have abundant evidence. The natives of Egypt, India, and of Hindostan seem alike to have placed the cow amongst their deities; and judging by her usefulness to all classes, no animal could perhaps have been selected whose value to mankind is greater.

According to the estimate of Mr. Youatt, to whom in this and other sections of this work I am so much indebted (*On Cattle*, p. 9), it would seem that 1,600,000 head of cattle are consigned to the butcher every year in the United Kingdom, and the value of the entire national stock of all kinds of cattle, sheep, and pigs, he is of opinion, amounts to nearly £120,000,000.

THE BREED AND CHOICE OF A COW.

The Jersey or Alderney Cow.

The young cow-keeper, especially if he is of the middle or upper classes of the community, and his land or other facilities for cow-keeping are of small extent, will naturally remember the Jersey, or, as it is improperly called, the Alderney cow—so small, so docile, so beautiful—and yielding such delicious milk and cream. The best of these cows, however, bear a much higher price than is within the means of many persons; and, besides, her yield of milk is not so copious in *measure* (though rich in quality) as that of cows of other breeds. As, however, many, into whose hands this work may find its way, will have facilities for keeping this beautiful animal, we can hardly, perhaps, take a better course than to hear the evidence of a distinguished Jersey cow-keeper on the points and successful treatment of this excellent little breed of cows, since so much of the matter which applies to this cow will be found valuable in the selection and management of all others. The conclusion, then, of Colonel Le Couteur, of Belle Vue, in the Island of Jersey (*Jour. R. A. S.*, vol. v., p. 43) is, that "the breed of cattle, familiarly known throughout Britain as the Alderney, and correctly termed in the article Cattle, of the 'Library of Useful Knowledge,' 'the crumpled horned,' was, it is conceived, originally Norman, as cows very similar to them in form and colour are to be seen in various parts of Normandy, and Brittany also; but the difference in their milking and creaming qualities is really astonishing, the Jersey cow producing nearly double the quantity of butter." This increased value of the breed, however, has been the result of long and careful attention to the selection of the animals possessing the best qualities.

"Ten years," adds the Colonel, "have elapsed since the attempt was first made by fixed rules to improve the form and quality of the Jersey cow. A few gentlemen, presided over by the then Lieutenant-Governor, Major-General Thornton, selected two beautiful cows, with the best qualities, as models. One of

these was held to be perfect in her barrel and fore-quarters; the other equally so in her hind-quarters. From these two the following points were laid down to be the rule for governing the judges in all the cattle-shows of the Jersey Agricultural Society. The accuracy of this arrangement is proved by the fact that no deviation from it has been made, the experience of ten years having only added to the scale the points for general appearance and condition.

Scale of Points for Cows and Heifers.

I.—Breed, on male and female sides, reputed for producing rich and yellow butter	4
II.—Head small, fine, and tapering; eye full and lively. Muzzle fine and encircled with white; horns polished and a little crumpled, tipped with black; ears small, of an orange colour within	8
III.—Back straight from the withers to the setting of the tail; chest deep and nearly of a line with the belly	4
IV.—Hide thin, moveable, but not too loose, well covered with fine and soft hair, of good colour.....	2
V.—Barrel hooped and deep, well ribbed home, having but little space between the ribs and hips; tail fine, hanging 2 inches below the hock	4
VI.—Fore legs straight and fine, thighs full and long, close together when viewed from behind; hind legs short, and bones rather fine; hoof small; hind legs not to cross in walking	2
VII.—Udder full, well up behind; teats large and squarely placed, being wide apart; milk veins large and swelling	4
VIII.—Growth	1
IX.—General appearance	1
Perfection for cows	30

"The Jersey cow is a singularly docile and gentle animal. In those bred on the heights of St. Ouen, St. Brelade, and St. Mary, there is a hardiness and a sound constitution that enable them to meet even a Scotch winter without injury; those bred in the low grounds and rich pastures are of a larger carcase, but are more delicate in constitution. Of the ancient race it was stated, perhaps with truth, that it had no tendency to fatten; indeed some cows of the old breed were so ungainly, high-boned, and ragged in form, Megs Merrilies of cows, that no attempt to fatten them might succeed—the great quantities of milk and cream which they produced probably absorbing all their fattening properties. Yet careful attention to crossing has greatly reme-

died this defect. By having studied the habits of a good cow with a little more tendency to fatten than others, and crossing her with a fleshy well-conditioned bull of a race that was also known to produce quality and quantity of butter, the next generation has proved of a rounder form, with a tendency to make fat, without having lost the butyraceous nature. Some of these improved animals have fattened so rapidly while being stall-fed, from the month of December to March, as to suffer in parturition, when both cow and calf have been lost; to prevent which it is indispensable to lower the condition of the cow, or to bleed, in good time. Such animals will fatten rapidly. Their beef is excellent; the only defect being in the colour of the fat, which is sometimes too yellow. It is now a fair question, whether the improved breed may not fatten as rapidly as any breed known?

"The grand desideratum," continues Col. Le Couteur, "is to discover a breed that will be useful to the grazier, the dairyman, and the small farmer. In so small a spot as Jersey, it is difficult to cross the breed essentially—a great step towards it is gained by crossing cattle bred in the low rich pastures with those of the exposed hills on the western or northern coast: these being smaller, finer boned, of a more hardy constitution, and feeding on a short rich bite, impart strength of constitution and hardihood to the larger and more delicate animals of the sheltered low grounds.

"It is believed that cattle are generally more healthy and free from epidemics here than in most countries. This may be attributable in some measure to the saline particles which, being so frequently in suspension over the island, are afterwards deposited on the herbage, and tend to its salubrity. After heavy gales, it is frequently found that the grass all across the island has a strong saline flavour. So partial are cattle to this flavour, that they will greedily devour grass which has been watered with sea-water which they previously rejected. Two pipes per acre, spread from an ordinary watering-cart, or from a pipe which may be made to pour into a long deal box perforated with holes, will be found of great utility where sea-water or salt can be obtained at small cost.

"The Jersey farmer treats his cow with gentleness and care; it might be more correct to say that his wife does so. On good farms she is usually housed at night after the end of October to the end of February, if heavy rain, hail, or snow prevail. It is deemed to be healthful to give a cow a short run daily through the winter, excepting in stormy weather. At this season, which is usually several degrees warmer than in the mildest part of Devonshire, she is fed with a certain portion of straw, from 10 lbs. to 20 lbs. of hay, with about 10 lbs. to 20 lbs. of parsnips, white carrots, turnips, or mangold-wurzel. The small portion of grass which she may pick up in the winter, with the above

quantity of food, enable her to produce a rich and well-coloured sample of butter till within six weeks of parturition. At this period, which is usually regulated to take place about the month of March or April, just when the cow, being in full milk, may soon be placed on the fresh spring pasture in April or May, she is an object of extreme care. On calving she is given a warm potation of cider, with a little powdered ginger. Quayle hints that pet cows are further indulged with a toast in their caudle. The calf is taken from the cow at once, and fed by hand. It may be well to advise that, on the first occasion of calving, the calf should be allowed to draw the cow fully; for no milking by hand will so completely empty the udder, nor cause the milk-veins to swell to their full development, as will the suction of the calf.

"Some of the early meadows produce rich grass in March; but the general flush of grass, which comes on generally late in April, is the period when the Jersey farmer looks forwards with anxiety.

"The cow is then tethered to the ground by means of a halter five or six feet long, this is appended by a ring and swivel to a chain, which encircles her horns, closed by a ring and bar; the other end of the halter is fastened to a chain 6 or 8 feet long, which is connected by a swivel and ring to a stout iron stake a foot long; this is driven into the ground by a wooden mallet. The cow having this circular range of 12 feet or more, is compelled to eat it clean. She is usually moved thrice a day, and milked morning and evening; on many farms at mid-day also.

"Under this system, the writer has owned four cows that produced eight-and-forty pounds Jersey, or above 51 lbs. imperial weight, of rich yellow butter per week, in the month of May and part of June.

"In very hot weather, in July or August, it is advisable to shelter the cow from the heat and flies; otherwise these tease cows to such a degree, by forcing them to run about incessantly, that they have no time for repose or for chewing the cud; they, in consequence, afford much less milk or cream.

"It was anciently thought that cream from the Jersey cow was too rich for making cheese. M. Le Feuvre of La Hague, who has a fine breed of cows, tried the experiment two years since, and succeeded to admiration. It was made from the pure milk, cream and all, as it comes from the cow. It was found that the quantity of milk that would have produced a pound of butter afforded 1½ lb. of cheese.

"From the quantity of milk which produced a cheese of 20 lb. weight, the *drainings* of the curds and whey, on being churned, yielded 4 lbs. of butter. This butter was of an inferior quality when eaten with bread, but was superior to any other for the making of pastry; it was peculiarly hard, and of excellent texture for such use in hot weather. The writer has tasted cheeses

from Mr. Le Feuvre's farm quite equal in quality to the richest double-Glo'ster.

"On one or two farms besides General Touzel's, butter is made from clouted cream in the Devonshire mode; but as this is not peculiar to Jersey, it is not noticed further than that 10 lbs. of butter are usually made in five minutes by this process. The usual way of procuring the cream is by placing the milk in pans about 6 inches deep—the glazed shallow earthenware having taken the place of the unglazed deep vessels.

"It is admitted that the richest milk and cream are produced by cows whose ears have a yellow or orange colour within. Some of the best cows give 26 quarts of milk in twenty-four hours, and 14 lbs. of butter from such milk in one week. Such are rare. Good cows afford 20 quarts of milk daily, and 10 lbs. of butter weekly, in the spring and summer months. Butter is made every second or third day.

"Jersey butter, made when the cows are partially fed on parsnips, or white carrots and grass, in September and October, when salted and potted, will keep till the following spring, preserving as well as Irish butter, with a much less rank flavour. The price of the best Jersey cows, including points and quality, is from £20 to £30; and up to £20 is given for the best heifers. Yearling bulls, of the best breed and points, from £10 to £15."

In the choice of a cow let me very earnestly impress upon the purchaser that her *youth* must be one chief consideration, for which hardly any other advantage will compensate. As a cow increases in years, her milk decreases in value, and yet her appetite *increases* at an equally rapid rate. Then again, when she is to be fatted off for the butcher, there is no amount or quality of food which can be given to an old cow that will remunerate her owner for the expense. Buy, then, a young cow, and dispose of her in some way or other (without she is *very good* for milk and butter) before she is more than six or seven years old, and just before calving.

The Devon Cow.

The cows of North Devonshire were pretty fairly described by the late Professor Youatt, as being generally of a red colour; many, however, are brown, whilst others are more of a chestnut colour. Those of a yellow colour are reputed in Devonshire to be subject to the *steat* (diarrhœa). The Devon cow has a full round clear eye, the countenance cheerful, the muzzle orange or yellow, the jaws free from thickness, and the throat from dewlap.

There is much difference of opinion with regard to the fitness of Devon cows for the dairy, it being pretty generally asserted that their acknowledged grazing qualities render them unfit for the dairy; that their milk is rich, but deficient in quantity; but

W.H.Davis
E. Hacker

W. H. Davis
E. Bucher

there are many very superior judges who prefer them even for the dairy. Of the calves, those which are dropped about Michaelmas time are preferred to those which are calved in January or February. They allow the calf to suck three times a day for a week; then new warm milk is given it for three weeks longer; then it has warm scalded milk mixed with a small portion of finely divided linseed cake, and its meals are gradually lessened, and at four months old it is entirely weaned (Youatt *On Cattle*, p. 7-25).

The Hereford Cow.

The oxen of Herefordshire are much larger than the Devon, and of a darker red; some are dark yellow, and a few brindled; they generally have white faces, bellies, and throats. They have thicker hides than those of Devonshire, and they are more hardy, and shorter in the carcass and leg; are higher, heavier, and broader in the chine; have more fat, and are rounder and wider across the hips; the thigh is more muscular, the shoulders larger (*Ibid.*, p. 31). Marshall long since described them pretty correctly as follows:—"The countenance pleasant, cheerful, open; the forehead broad; eye full and lively; horns bright, taper, and spreading; head small; chap lean; neck long and tapering; chest deep; bosom broad, and projecting forward; shoulder-bone thin, flat, no way protuberant in bone, but full and mellow in flesh; chest full; loin broad; hips standing wide, and level with the spine; quarters long, and wide at the neck; rump even with the general level of the back, not drooping, nor standing high and sharp above the quarters; tail slender, and neatly haired; barrel round and roomy, the carcass throughout deep and well spread; ribs broad, standing close and flat on the outer surface, forming a smooth even barrel, the hindmost large and of full length; round bone small, snug, not prominent; thigh clean, and regularly tapering; legs unright and short; bone below the knee and hough small; feet of middle size; flank large; flesh everywhere mellow, soft, yielding pleasantly to the touch, especially on the chine, the shoulder, and the ribs; hide mellow, supple, of a middle thickness, and loose; coat neatly haired, bright, and silky; colour of a middle red, with a bald face, characteristic of the true Herefordshire breed."

The Hereford cows are worse milkers than those of Devon, but then they will grow fat where a Devon would starve. The beef is sometimes objected to from the largeness of the bone, and the coarseness of some of the inferior pieces, but the best sorts are generally excellent. Mr. Youatt gives an account of an experiment in feeding, made in the winter of 1828-9, between the Herefords and the improved short-horns, which, although by no means decisive of the merits of either breed, yet is worthy of notice by the grazier.

The Sussex Cow.

The Sussx cow is not a favourite with the generality of farmers. She does not answer for the dairy, for her milk, although of very good quality, is far inferior in quantity to either the Holderness or the Suffolks. They are, moreover, what their countenance indicates—of an unquiet temper, and are commonly restless and dissatisfied, especially if not bred on the farm on which they are kept. They are, therefore, chiefly kept as breeders; are generally in fair condition, even while milking; and no cows, except the Devon or Hereford, will thrive so fast after being dried; they fatten even faster than the ox. Nearly all the calves are reared, adds Mr. Youatt—the males for work, nad the females for breeding or early fattening (*On Cattle*, p. 40).

The Welsh Cow.

The cattle of Wales are principally of the middle-horns, and stunted in their growth from the poverty of their pastures. Of these there are several varieties. The Pembrokeshire are chiefly black, with white horns; are shorter legged than most other Welsh cattle; are larger than those of Montgomery, and have round and deep carcasses; have a lively look and good eyes; though short and rough, not thick; have not large bones, and possess, perhaps, as much as possible, the opposite qualities of being very fair milkers, with a propensity to fatten. The meat is equal to the Scotch. They will thrive, says Mr. Youatt, where others starve; and they rapidly outstrip most others when they have plenty of good pasture. The Pembroke cow has been called the poor man's cow.

The Scotch Cow.

Of the Scotch cow there are several excellent varieties.

Ayrshire has a peculiarly fine breed of dairy cattle, which is thus described by Mr. Aiton, in his excellent treatise (p. 26.) on the dairy breed of cows:—"The most approved shapes in the dairy breed are, small head, rather long and narrow at the muzzle; eye small, but smart and lively; the horns small, clear, crooked, and their roots at considerable distance from each other; neck long and slender, tapering towards the head, with no loose skin below; shoulders thin; fore-quarters light; hind-quarters large; back straight, broad behind; the joints rather loose and open; carcass deep, and pelvis capacious and wide over the hips, with round fleshy buttocks; tail long and small; legs small and short, with firm joints; udder capacious, broad, and square, stretching forward, and neither fleshy, low hung, nor loose: the milk veins are large and prominent; teats short, all pointing outwards, and at considerable distance from each other; skin thin and loose; hair soft and woolly; the head,

bones, horns, and all parts of least value, small; and the general figure compact and well proportioned." (*Youatt*, p. 127.)

"The qualities of a cow," adds Mr. Aiton in another place, "are of great importance. Tameness and docility of temper greatly enhance the value of a milch cow. Some degree of hardiness, a sound constitution, and a moderate degree of health and spirits, are qualities to be wished for in a dairy-cow, and what those of Ayrshire generally possess. The most valuable qualities which a dairy cow can possess are that she yields much milk, and that of an oily, butyraceous or caseous nature; and that after she has yielded very large quantities of milk for several years, she shall be as valuable for beef as any other breed of cows known; her fat shall be much more mixed through the whole flesh, and she shall fatten faster than any other." And again, "the best Scotch dairy cows yield 1000 gallons of milk in one year; and in general, from 3¾ to 4 gallons of their milk will yield 1½ lbs. of butter, and about 27½ gallons will produce 1½ stone imperial of full milk cheese."

The Galloway polled cattle are a peculiarly fine and valuable breed. They are described by Mr. Youatt, on the authority of the author of the *Survey of Galloway*, as straight and broad in the back, and nearly level from the head to the tail—round in the ribs, and also between the shoulders and the ribs, and the ribs and the loins—broad in the loins without any large projecting hook-bones—long in the quarters and ribs, and deep in the chest, but not broad in the twist. There is much less space between the hook or hip-bones and the ribs than in most other breeds. They are short in the leg, and moderately fine in the shank-bone. The happy medium seems to be preserved in the leg, securing hardihood and a disposition to fatten. With the same cleanness and shortness of shank, there is no breed so large and muscular above the knee, while there is more room for the deep broad and capacious chest. They are clean, not fine and slender, but well proportioned in the neck and chaps; a thin and delicate neck would not correspond with the broad shoulders, deep chest, and close compact form of the breed. The neck of the Galloway bull is thick even to a fault. The Galloway has a loose mellow skin of medium thickness, with long soft silky hair. The skin, which is thinner than the Leicester, is not so fine as the improved Durham, handles soft and kindly. Their colour is commonly black, but there are several varieties; the dark coloured are preferred from their being considered to indicate hardness of constitution. 30,000 of these are estimated to be sent yearly out of Galloway to the south (Youatt *On Cattle*, p. 158). The Galloway breeders prefer allowing the calves to suck the cow; they consider they thrive materially better than those fed from the pail, and that fewer die of stomach complaints. Another valuable breed of polled cows is bred in Angus, which much resemble in appearance

those of Galloway; they are, however, rather larger and longer in the leg, flatter sided, and with thinner shoulders.

In Norfolk and Suffolk a polled breed of cows prevails, which are almost all descended from the Galloway cattle, "whose general form," says Mr. Youatt (p. 172), "they retain with some of, but not all, their excellences; they have been enlarged, but not improved, by a better climate and soil. They are commonly of a red or black colour, with a peculiar golden circle around the eye. They are taller than the Galloways, but thinner in the chine, flatter in the ribs, and longer in the legs; rather better milkers; of greater weight when fattened, though not fattening so kindly, and the meat not quite equal in quality."

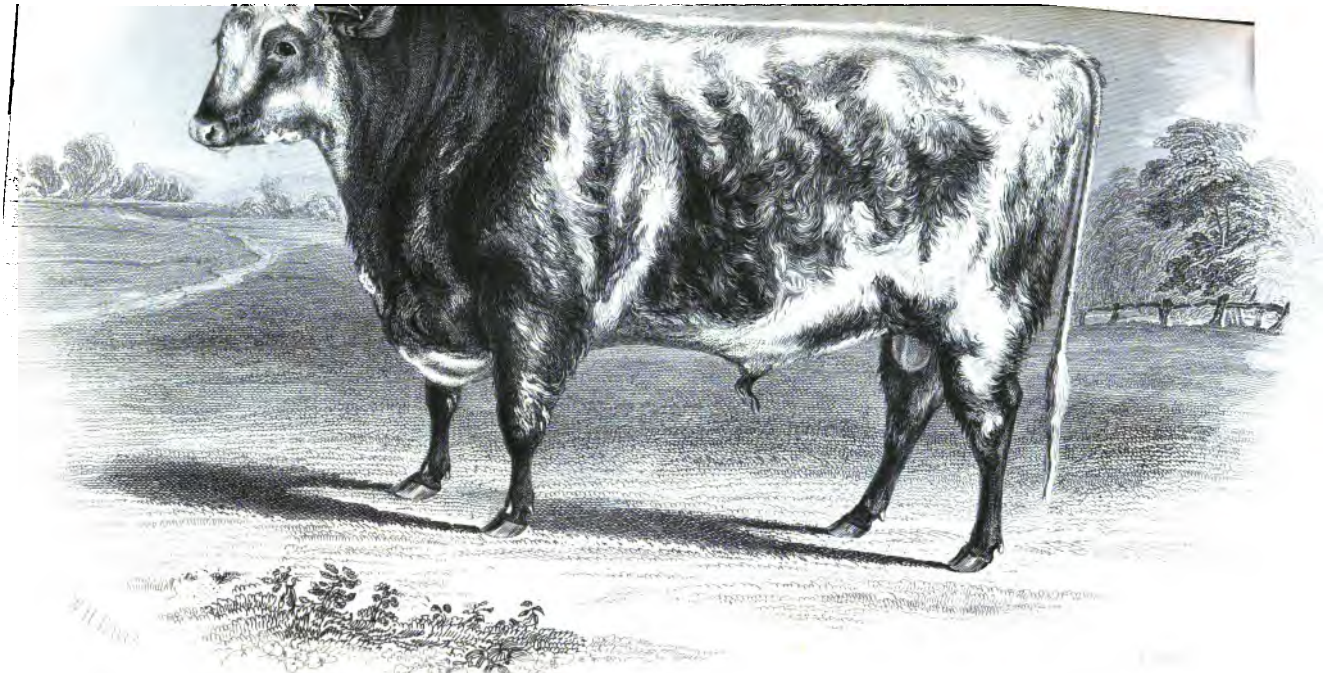
The Suffolk dun cow, which is also of Galloway descent, is celebrated as a milker, and, there is little doubt, is not inferior to any other breed in the quantity of milk which she yields; this is from six to eight gallons per day. The butter produced, however, is not in proportion to the milk. It is calculated that a Suffolk cow produces annually about 1½ cwt. of butter.

The Durham Shorthorn.

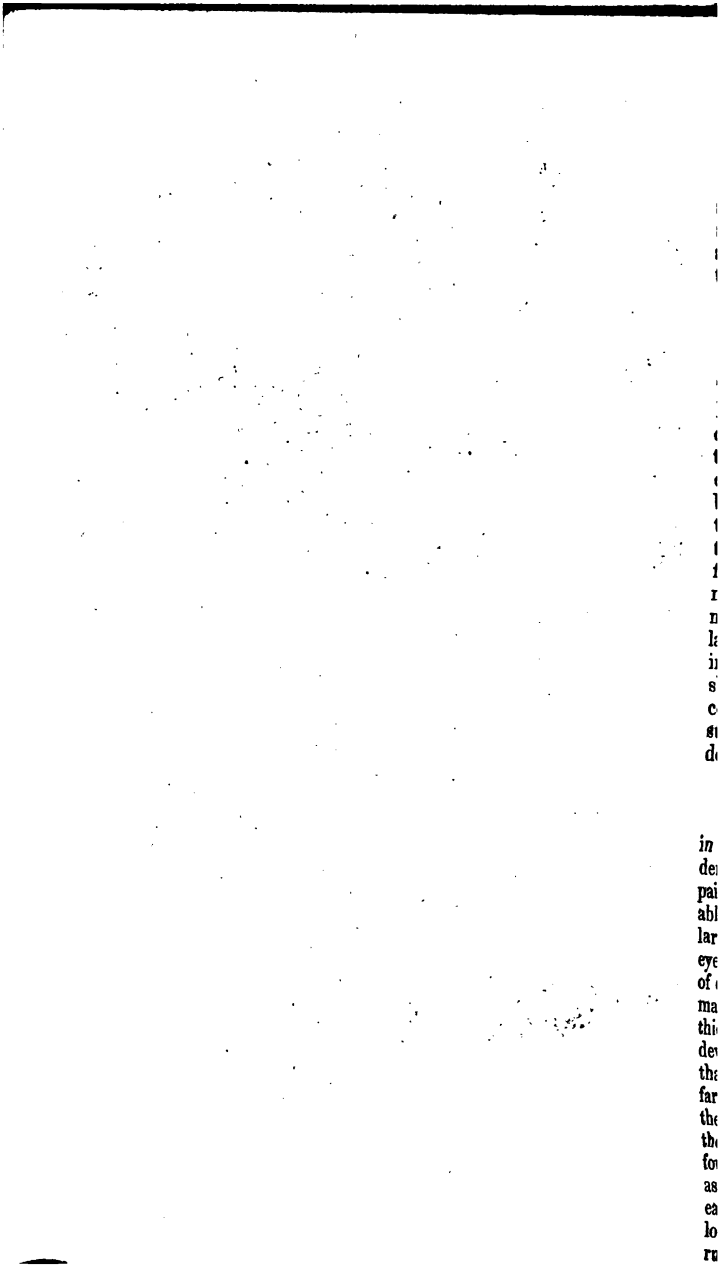
Of this noble breed of cattle, which seem to be annually increasing in favour with the dairyman and the grazier, we are mainly indebted to the description of the late Rev. Henry Berry. Durham and Yorkshire have for ages been celebrated for a breed of these, possessing extraordinary value as milkers, "in which quality," says Mr. Youatt, "taken as a breed, they have never been equalled. The cattle so distinguished were always, as now, very different from the improved race. They were generally of large size, thin skinned, sleek haired, bad handlers, rather delicate in constitution, coarse in the offal, and strikingly defective in the substance of girth in the fore-quarters. As milkers they were most excellent; but when put to fatten, as the foregoing description will indicate, were found slow feeders, producing an inferior quality of meat, not marbled or mixed as to fat and lean; the latter sometimes of a very dark hue. Such too, are the *unimproved* shorthorns of the present day."

The colours of the improved shorthorns are red or white, or a mixture of both; "no *pure improved shorthorns*," adds Mr. Youatt, "are found of any other colour but those above named." That the matured shorthorns are an admirable grazier's breed of cattle is undoubted; they are not, either, to be disregarded as milkers; but they are inferior, from their fattening qualities, to many others as workers.

"In its *points*," says Mr. James Dickson (*Quart. Journ. of Agr.* vol. vi. p. 269), "for quantity and well laid on beef, the shorthorn ox is quite full in every valuable part; such as along the back, including the fore-ribs, the sirloin and rump, in the runners, flanks, buttocks, and twist, and in the neck and brisket as inferior parts. In regard to quality of beef, the fat bears a



Favourite a Short Horned Bull at 16 months old.



due and even preponderating proportion to the lean, the fibres of which are fine and well mixed, and even marbled with fat, and abundantly juicy. The fine, thin, clear bone of the legs and head, with the soft mellow touch of the skin, and the benign aspect of the eye, indicate in a remarkable degree the disposition to fatten; while the uniform colours of the skin, red or white, or both commixed in various degrees, bare cream-coloured skin on the nose and around the eyes, and fine, tapering, white, or light coloured horns, mark distinctly the purity of the blood; these points apply equally to the bull, the cow, and the heifer. The external appearance of the shorthorn breed," adds Mr. Dickson, "is irresistibly attractive. The exquisitely symmetrical form of the body in every position, bedecked with a skin of the richest hues of red, and the richest white, approaching to cream, or both colours, so arranged or commixed as to form a beautiful fleck or delicate roan, and possessed of the mellowest touch; supported on clean small limbs, showing, like those of the race-horse and the greyhound, the union of strength with fineness; and ornamented with a small, lengthy, tapering head, neatly set on a broad, firm, deep neck, and furnished with a small muzzle, wide nostrils, prominent 'mildly beaming' eyes, thin large, biney ears set near the crown of the head, and protected in front with semicircularly bent white or brownish coloured short (hence the name) smooth pointed horns; all these parts combine to form a symmetrical harmony, which has never been surpassed in beauty and sweetness by any other species of the domesticated ox." (*See frontispiece to this work.*)

The Yorkshire Cow.

The Yorkshire cow is that generally found in the great dairies in the vicinity of London, and in these the character of the Holderness and the Durham unite. "A milch cow good for the pail as long as she is wanted, and then quickly got into marketable condition, should have a long and rather small head; a large headed cow will seldom fatten or yield much milk. The eye should be bright, yet with a peculiar placidness and quietness of expression; the chaps thin, and the horns small. The neck may be thin towards the head; but it must soon begin to thicken, and especially when it approaches the shoulder; the dewlap should be small; the breast, if not so wide as in some that have an unusual disposition to fatten, yet should be very far from being narrow, and it should project before the legs: the chine to a certain degree fleshy, and even inclining to fulness; the girth behind the shoulder should be deeper than is usually found in the shorthorn; the ribs should be spread out wide, so as to give as globular a form as possible to the carcass, and each should project farther than the preceding one, to the very loins. She should be well formed across the hips, and on the rump, and with greater length there than the milker genera

possesses, or if a little too short, not heavy. If she stands a little long on the legs, it must not be too long. The thighs somewhat thin, with a slight tendency to crookedness or being sickle-hammed behind; the tail thick at the upper part, but tapering below; and she should have a mellow hide, and but little coarse hair. Common consent has given to her large milk veins. A large milk vein certainly indicates a strongly developed vascular system, one favourable to secretion generally, and to that of the milk amongst the rest. The udder should rather incline to be large in proportion to the size of the animal, but not too large; its skin thin and free from lumps in every part of it; the teats of a moderate size. The quantity of milk given by some of these cows is very great; it is by no means uncommon for them in the beginning of the summer to yield thirty quarts a day. There are rare instances of the cow yielding thirty-six quarts; the average is about twenty-two to twenty-four quarts. The milk, however, is not so rich in its produce of butter as that of the long-horns, the Scotch, or the Devons."—(*Johnson's Farmers' Encyclopædia*).

THE TREATMENT OF A COW.

THE HEALTH OF A COW.

The health of the cow is the first consideration to be regarded: without she is in health all other favourable circumstances are useless. The cow-keeper must remember that several things are needed to keep his cow in health for any considerable period. She needs fresh air, for instance, and a certain degree of exercise, hence stall-fed cows are not in general healthy—a loose box opening into a small yard, well sheltered from the north and east winds, and open to the south and west, is a much better place for a cow; she then enjoys fresh air and the exercise of walking around her little enclosure. Her yard and shed should be kept as clean and dry as possible, her hovel well furnished with good water and clean straw—its doorway not too large, and in winter kept at least partially closed, with a hanging of sacking or other material, which she can readily push aside as she passes to and fro. A smooth round post in the middle of the yard, against which she can rub herself, is a comfort which should always be added. This constant rubbing of the cows against hard substances points out, in very natural language, the advantage they derive from the occasional disturbance of the scurf of the skin, as by the curry-comb, an application which should never be long omitted. It promotes their health too by its tendency to promote cleanliness—to which I will next allude.

CLEANLINESS OF THE COW-SHED AND THE COW-YARD.

It is only of late years that the advantage of cleanliness to a cow has been understood, the practice of our forefathers

with regard to this condition of the live stock of the farm was rude and barbarous. About two centuries since, Gervase Markham, in his "Cheap and Good Husbandry," p. 72, gives, amongst many others dispersed through his work, a rather striking instance. He says, "If you do see the ox lick himself all over, it is a good sign that he is marketable and well fed, for it shows soundness and that the beast taketh a joy in himself; yet while he doth so lick himself he feedeth not, for his own pride hindereth him, and therefore the husbandman will lay the ox's own dung upon his hide, which will make him leave off licking and take to his food." Time and increase of knowledge has strangely altered the general treatment of cattle since Gervase Markham thus directed the husbandmen who were his contemporaries. In how different a spirit does a successful and enlightened modern stockowner, Mr. G. Dobito, when addressing his brother graziers, justly enlarge incidentally upon the benefits of the most careful cleanliness for the stall-fed ox. "The morning's bait, one bushel of swedes, *well cleaned from dirt*, and cut small, given a few at a time; then the refuse pieces being well cleaned out, a dry bait, consisting of 2 lb. of oil-cake, 3 lb. of pollard, and a little hay chaff. While they are feeding the manure and wet litter must be well cleared away, and any which may be on the bullocks taken off, the floor swept clean, and plenty of fresh litter put in; then have every bullock well brushed with what is called a dandy-brush (being a brush made with whalebone for taking the rough dirt off horses). Let not any slovenly farmer fancy this to be a whim of mine; depend upon it, the bullocks are kept in much better health and greater comfort for it." "Be careful," he adds in another place, "that the mangers are well cleansed out between every bait. I have mine cleansed at the commencement of the season, and as often afterwards as I think necessary, with scalding water and the scrubbing brush. It will be observed," he continues, "that cleanliness, warmth, and quiet are the great points I insist upon, of course coupled with good feeding; but very many tons of oil-cake are annually wasted, because the comfort of the animals is not more attended to." (*Journ. R. A. S.*, vol. vi., p. 77).

The results of an inattention to cleanliness are found in the accumulation of large heaps of decomposing litter in the very stalls of the fattening oxen, or around the doors and windows; the progress of such decomposition is injurious to the animal by the gases of putrefaction which hence arise, and mix with the atmosphere in which it is placed. Few regard these, and a still less number of persons are aware of the pernicious nature of the chief of these gases, the carburetted and the sulphuretted hydrogen, when inhaled by animals. The evidence of Dr. W. H. Duncan, Physician to the Liverpool Infirmary, contains several important facts on this subject; and although his testimony (*Report of the Sanitary Commission*, p. 139) was directed to the

noxious effects of dirt and undrained localities upon the health of the inhabitants in crowded towns, his remarks are also pertinent to the ills and disadvantages to the health of animals from a similar neglect of cleanliness. When speaking of the effluvia so pernicious to health emitted by cesspools, &c., he observes:— The principal gas given out from these deposits is sulphuretted hydrogen, the most deadly of the gaseous poisons, two or three cubic inches causing instant death when injected into a vein, or into the chest, or beneath the skin of animals. A rabbit died in ten minutes after being enclosed in a bag containing sulphuretted hydrogen, although its head was left free so as to allow it to breathe the pure atmosphere. Nine quarts injected into the stomach of a horse killed it in a minute; and I have heard it stated that it is difficult to keep horses in high condition in the immediate neighbourhood of large privies, where sulphuretted hydrogen is abundantly given out. Even when largely diluted with atmospheric air, it retains in a great degree its noxious properties. A dog was killed by being made to breathe a mixture of one part of this gas and 800 parts of common air; and air containing only 1-1500th part of sulphuretted hydrogen proves speedily fatal to small birds. If the principal ingredient in these emanations is capable of exerting such destructive agency, we should expect it to have shown its effects occasionally on the men employed in clearing out the places where it accumulates. Various instances of this kind are, in fact, on record, in some of which immediate death followed the incautious inhalation of the effluvia in a concentrated form; and in others, where the gases were more diluted, the persons breathing them became faint, delirious, and insensible, or were seized with convulsions even when they ultimately recovered. Although these effluvia are breathed by the inhabitants of our courts and back streets, in a state, of course of extreme dilution, we cannot suppose," adds Dr. Duncan, "that they are, on that account, entirely harmless; what in a concentrated form is so very deadly, must in a diluted state be injurious to health."

In the stable, the same pernicious emanation of gases is going on, and as the urine of the horse abounds with ammonia, which also rises and mixes with the air the horses consume, the same injury accrues, although often in too gradual and quiet a way for the diseases so produced being traced to their true source. "In many dark and ill-managed stables," remarked the late Professor Youatt, the ablest veterinarian of his day, "a portion of the dung may be swept away, but the urine lies for days at the bottom of the bed, the disgusting and putrefying nature of which is ill-concealed by a little fresh straw, which the lazy horse-keeper scatters over the top." The stables of the gentleman are generally kept hot enough, and far too hot, although in many of them a more rational mode of treatment is beginning to be adopted; but they are lofty and roomy, and the horses are not

too much crowded together, and a most scrupulous regard is paid to cleanliness; glanders seldom prevail there. The stables of the farmer are commonly ill-managed and filthy enough, and the ordure and urine sometimes remain from week to week, until the horse lies on a perfect dunghill, while there is no declivity to drain away the moisture, nor any regular pavement to prevent it from soaking into the earth, nor any water to clean even the surface; and the only instrument of purification is an old stumped broom. Glanders, it is true, seldom prevail there, for the same carelessness which permits the filth to accumulate leaves many a cranny for the wind to enter, and sweep away the fumes from this badly roofed and unceiled place. The stables of the horse dealer are hot enough, but a principle of strict cleanliness is enforced, for there must be nothing to offend the eye or the nose of the customer, and then glanders are seldom found. But if the stables of many of our post horses, and of those employed on our canals, be examined—almost too low for a tall horse to stand upright, too dark for the accumulation of dirt to be perceived, too far from the eye of the master, ill-drained, and ill-paved, and governed by a false principle of economy which begrudges the labour of the man and the cleanliness and comfort of the animal, these will be the very hot-beds of the disease, and in many of these establishments it is an almost constant resident. Improper stable management we believe to be a far more frequent cause of glanders than contagion. The air which is necessary to respiration is changed, and empoisoned in its passage through the lungs, and a fresh supply is necessary for the support of life. That supply may be sufficient barely to support life, but not to prevent the vitiated air from again and again passing through the lungs, and producing irritation and disease. The membrane of the nose, possessed of extreme sensibility for the purposes of smell, is easily irritated by this poison; and close and ill-ventilated stables we have seen oftenest witness the ravages of glanders. Professor Coleman relates a case, which proves the rapid and fatal agency of this cause. In the expedition to Quiberon, the horses had not been long on board the transports, before it became necessary to shut down the hatchways, for, we believe, a few hours only; the consequence of this was, that some of them were suffocated, and that all the rest were disembarked, either glandered or farcied. We have then abundant evidence of the advantages derived from cleanliness in the management of cattle and horses, and with regard to sheep the experience of all flockmasters concurs in favour of the pernicious effect upon the animal of locating it in wet and miry places. In the course of the inquiries carried on by the commissioners on sanitary reform several instances of this fact were cited, and although these were intimately mixed up with the evidence relating to the ill results of diet upon mankind, yet the testimony is not for that reason the less valuable.

"The sanitary effect of road cleaning," observes Mr. Chadwick (*Report*, p. 88), "to which house drainage and road drainage are auxiliary, it appears is not confined to the streets in towns and the roads in villages, but extends over the roads at a distance from habitations on which there is traffic." Dr. Harrison, whose testimony he cites on the subject of the analogy of the diseases of animals to those which affect the human constitution, in treating of the prevention of fever or the rot amongst sheep, warns the shepherd that, after providing drained pasture, and avoiding "rotting places" in the fields, all his care may be frustrated if he do not avoid, with equal care, leading the sheep over wet and miry roads, with stagnant ditches, which are as pernicious as the places in the fields designated as "rotting places." He is solicitous to impress the fact that the rot—that is, the typhus fever—has been contracted in ten minutes; that sheep can at "any time be tainted in a quarter of an hour, while the land retains its moisture, and the weather is hot and sultry." Such instances of the prejudicial effects of undrained and neglected roads might be easily multiplied. Thus Mr. E. P. Turner, the medical officer of Coleshill Union, in accounting for some cases of fever, states, "These cases of typhus all occurred in the same neighbourhood, where the road is bad, and a dirty ditch of stagnant water on each side of it; the road is generally overflowed in the winter. The disease broke out in the month of October; other cases occurred in the same neighbourhood at the time."

Even in the case of pigs it has been found that cleanliness conduces very materially to their health and advancement in fatness. This is a better understood fact amongst some of the pig owners of the New World than in our own country. In Mexico the pigs are frequently given a cold bath, as the breeders attest that they find that by thus securing the cleanliness of their herds, they grow more rapidly upon less food. A well known experiment was long since made by a Norfolk farmer, to try what effect cleanliness produced upon pigs. Six pigs, of nearly equal size, were put up at the same time, and for seven weeks fed and littered in the same way. Three of them were left to shift for themselves as to cleanliness; the other three were kept as clean as possible with a currycomb and brush employed for the purpose. The result was, the last consumed in seven weeks fewer peas by five bushels than the other three, yet when they were killed they weighed more by two stone and four pounds. Arthur Young, in his survey of Norfolk, dwells at some length upon the advantages of cleanliness to swine: he quotes in one place the words of Captain Glasspole, of Ormsby, who seems to have been the Fisher Hobbs of his day amongst pig breeders. "Pigs require to be kept warm, dry, and clean; washing them occasionally with warm soap-suds is very beneficial, and they will lie down to be scrubbed as soon as they see

the soap and brush." In the treatment, then, of all our domestic animals, we may safely conclude that there is not any description of them that do not prosper better under a system of cleanliness, than under the discomforts of a life of dirt. It is a theory which we should prize if it was only for the comfort to which it leads, and even if we were not well assured of the increased profit which systematic cleanliness in the case of live stock insures, still I am convinced that few intelligent stock owners will deny the reward of cleanliness to be ample in the increased comfort and enjoyment which it diffuses around the farm-yard.

CLEANLINESS OF THE COW'S PASTURE.

The cleanliness of the cow-yard is not the only thing to be regarded: the wholesomeness of her pasturage is equally important. Now, her pasture may be unhealthy from several causes: the most common of these are—1, bad drainage; 2, the existence of foul ditches, with only stagnant, bad water for her to drink. Let us then confine our attention to these two sources of her comfort and disease, viz.: to the water drunk, and to the effect of allowing bad water to saturate the land on which they graze, or the ditches and yards by which they are surrounded. I am led to dwell on these by some of the answers received by Lord Carlisle, in answer to a circular addressed to various practical farmers and others, in which, amongst other inquiries, the following question was put:—"Can you give any example of the effects of thorough drainage in improving the healthiness of localities, as respects both the population and the cattle or stock?" In one of the answers received to this valuable circular, Mr. Alexander Maccaw, of Ardlocan, remarked—"I cannot speak decidedly as to its effects on population. People living in this district recollect when fever and ague prevailed, previous to the drainage of a swampy piece of land, called Turnberry Park, and ever since drainage was only partially done, that epidemic has been unknown. As to cattle, I have the strongest evidence of its beneficial effects. A portion of a large field in my occupancy, which was a few years ago marsh, and on which the stock was subject to the disease called red water, which proved some years very fatal, underwent thorough drainage and cultivation, after which the cattle never were affected with it. In another farm—Main's, of Kirkmichael—in a neighbouring parish, the stock on its marshy ground had also been very unhealthy; but after drainage it became quite the reverse. Instances of pleuro-pneumonia in stock have also been observed to be more virulent in low marshy lands. Of this fact the farms of Grange, in Ayrshire, and of Meikle Carse, in Kirkcudbrightshire, are striking examples. In the latter two successive stocks of cattle were nearly destroyed." "I believe," he justly concludes, "that the thorough drainage of a single swamp on any farm or locality must be the means of promot-

the health both of the population of such farm and its locality." Mr. Smith, of Deanston, observed that in the alluvial clay district of Stirlingshire and west of Perthshire, where the drainage was formerly effected by large open ditches in the Dutch fashion, ague was periodically prevalent, and rheumatism, fevers, and scrofulous affections were much promoted, until the introduction of thorough drainage forty years ago, after which period those diseases began to disappear, or to be greatly mitigated in severity. Few cases of ague now appear; fevers are seldom known, except in the usual course of fevers which prevail epidemically over the whole country; and it is generally observed by the inhabitants that their cattle or stock are now less subject to disease. In the undrained condition of those districts they were subject to dense fogs, especially in the autumnal months, when much rain had fallen, communicating a chilly feeling to the inhabitants; but since the general introduction of thorough draining, these fogs seldom prevail unless in a general foggy tendency of the atmosphere of the country. On the farm of Deanston, in the west of Perthshire, consisting of about two hundred acres, and which was the first farm on which the entire system of thorough draining and subsoil ploughing was introduced, there was a marked effect produced. The farm, after periods of rain, used to be covered with chilly fogs, which entirely disappeared after the thorough draining was effected. The cattle grazing on the farm were much subject to the disease called "red water;" since the draining there has been no case of that disease. Could any more decisive evidence be wished on this important question? Is it not an additional motive for thorough drainage, where its beneficial influence is found to be not merely confined to the increase of the health and vigour of vegetable life? The observations of Mr. Robert Neilson, of Hallwood, were equally valuable. "In the Altcar meadows, belonging to the Earl of Sefton, a low level district about eight or ten miles north of Liverpool," he observes, "a water wheel was erected about five years ago, for the purpose of relieving the land from inundation, and though thorough drainage has been very little adopted, the inhabitants already speak of the salubrity of the locality, while the equally increased fertility of the land has created a marked improvement in the condition of the stock. In my own neighbourhood," he continues, "some low flat land of a stiff clay soil, and lying extremely wet, always had a scouring effect on the young stock turned into it in the spring, and no alteration of manure produced in it any alteration. It was drained, and without any other change in the management, the same species of stock throve on it extremely well. I have also," he concludes, "had several opportunities of witnessing similar effects in the West Indies, and particularly British Guiana, where I resided several years; the surface is almost a dead flat, lower than the sea at high water, and drained

only at considerable expense by large sluice gates for *every* estate, which are opened at each period of low water. When an estate is abandoned, this is neglected, and its neighbourhood is invariably the first to suffer, on the approach of an epidemic; and I have known instances of the course of a fever thus produced being checked and materially altered by the neighbouring lands being drained—an alteration considerably accelerated by a small quantity of lime, in a purely powdered state, being distributed on the lands during a windy day." Of the general benefits of extensive drainage on the district, Mr. L. H. Spooner, of Balmacara House, Loch Alsh, observes, "Apart from the benefits derived in an agricultural view, drainage on an extensive scale must ameliorate the climate of districts in which it is practised, and in a great measure tend to purify their atmosphere. Water that is stagnant, shallow water, and water mechanically separated, as it is when held in soil, is far more susceptible of evaporation than when in motion, as a river; or combined in a large body, as in a lake or the sea; and it is a well-known fact that evaporation is always accompanied with a diminution of temperature. Now the constant motion in which water is kept by drainage, and its removal at such a depth below the surface as to prevent its being acted upon by the sun's influence, must of necessity also prevent excessive evaporation with its concomitant reduction of temperature." "And," adds Mr. Maccaw, "thorough drainage will introduce a more improved system of husbandry by extended cultivation of roots and green crops (the solid foundation of agriculture), and an immense increase of food from the same extent of land at present under unprofitable cultivation, or at least of doubtful remuneration. It will also give employment to an increasing population, and ameliorate our climate, rendering our harvest from ten to fourteen days earlier, and more healthy for population and live stock." It is not only the gases emitted from the stagnant water of marshes, and other places where decomposing organic matters are abounding, that the chemist detects. He finds, it is true, noxious gases, such as sulphuretted and carburetted hydrogen, so injurious to the health of animals; but the analyst finds in the salts of lime, which commonly are present in all hard waters, substances which there is little reason to doubt by their presence render the water less suitable than *soft* water for our domestic animals. In the case of the horse this was noticed by the late Professor Youatt in his valuable work on the horse, p. 359. He long since told his readers, "The farmer lets his horses loose morning and evening, and they go to the nearest pond or brook and drink their fill, and no harm results; for they obtain that kind of water which nature designed them to have, in a manner prepared for them by some unknown influence of the atmosphere, as well as by the deposition of many saline admixtures. The difference between hard and soft water is known to every one.

There is nothing in which the difference between hard and soft water is so evident, as in the stomach and digestive organs of the horse. Hard water drawn fresh from the well will assuredly make the coat of a horse, unaccustomed to it, stare, and it will not unfrequently gripe and otherwise injure him; instinct, or experience has made even the horse conscious of this, for he will never drink hard water if he has access to soft. He is injured, however, not so much by the hardness of the well water as by its coldness, particularly by its coldness in summer, and when it is many degrees below the temperature of the atmosphere. The water in the brook and the pond being warmed by long exposure to the air, as well as having become soft, the horse drinks freely of it without danger." These valuable observations will be regarded by my readers not only as most important in themselves, but as showing the value of the labours of the chemical philosopher on examining the various substances which surround and influence the success of the cowkeeper.

THE FOOD OF COWS.

The food of the milch cow next demands our attention. In this difficult section of the work, I would warn the young cowkeeper not to expect clear and precise directions adapted to every place and kind of food. The utmost that can be offered, in a work intended to be generally useful, are plain, good principles, such as will serve the cow-keeper in almost all situations. The chief of these principles may be included under the following heads;—

1. Good wholesome food.
2. *Regular*, and *frequent* feeding, in small portions.
3. Change of food, as often as possible.
4. Cleanliness of the food.
5. The avoidance of such food as is in too concentrated a state.

The food of live stock is a difficult theme, which has long engaged the attention of the most celebrated graziers; of late too, the chemist has come to the farmer's aid, and a fresh stimulus has thus been given to the inquiry. We must remember, too, for our encouragement, as I have elsewhere observed (*Bell's Messenger*), that if the extreme difficulty of the research had been allowed as a sufficient reason for resting content with our knowledge of the economy of animals, our information would have been still more limited than now. The diseases, the food, the grazing, and the food-producing qualities of our live stock, would then have been far less understood than at present. It is true, indeed, that in all these things our knowledge is yet imperfect, our confidence only limited, and our doubts and difficulties manifold. Still the consciousness of these things must not deter us; we must be urged forward by the remembrance of the by-gone onward, although laborious, labours of such men

as Bakewell, Collings, and Youatt, of the last generation, and of Webb, and Grantham, Liebig, and Thomson of the present. Let us, like them, when attempting to blend together the requisitions of the practical farmer with those of the man of science, take the only true road to useful science—practical knowledge; let us keep to facts, and avoid hasty and often injurious generalizations, which too frequently delude, instead of aiding the reader of nature's book. It is refreshing to us, in all our labours, to find in the same field of usefulness an enlightened practical farmer advocating the same cautious course of proceeding. Thus, on the very subject of this section, the food of cows, Mr. H. W. Keary, of Longlands, near Holkham, well remarks (*Journal of the Royal Agricultural Society*, vol. ix., p. 451), in the course of a valuable prize essay on the management of cattle, that it would be absurd and unprofitable in practice to attempt to lay down any precise rule as to what sort of artificial food should be used, since many circumstances must influence the selection. In making this admission, however, he at the same time remarks upon the many principles on which there is little doubt of their general correctness, and equally extensive value; thus he truly observes, that "the *treatment* of milch cows will materially influence the quantity and quality of their milk, and the judicious use of roots; and that artificial food in moderate quantities during the winter months generally yields a liberal return. It is, however, extremely important not to overload the stomach, or give anything which may cause indigestion; for so intimate is the connection between the stomach and the udder, that the slightest disorder in the former is immediately communicated to the latter, to the injury of the milk. Small quantities of food, given frequently, are more conducive to health and the production of milk, than an unlimited and constant supply of roots, hay, &c., &c. The quality of the water is also a matter of great importance, and one which is frequently overlooked, if we may judge from the filthy compounds which some cattle are allowed to drink. They are frequently watered at a dirty horse-pond adjoining the farmyard, contaminated by the excrement of cattle and the drainage of dung-heaps. Can it be doubted that so impure a liquid must produce disagreeable effects on the milk in the first place, and eventually on the health of the animals?" With regard to the comparative value and feeding qualities of different kinds of food, I am to a very great extent inclined to agree with Mr. Keary, when he adds, that he is "by no means satisfied that any single experiment, or even a series of them, are or ought to be at all conclusive, when we examine practically the difficulty of the question they are required to decide. For instance, suppose six oxen are taken to test the effects of two different modes of fattening; three to be treated on one system, and three upon another. How difficult it is, we all know, to select six animals

from any drove, however large, possessing in the same degree equal and similar qualifications; and hence the difficulty, not to say impossibility, of deciding fairly by any very limited experimental results. A close and careful observation," concludes Mr. Keary, "in our daily practice of the different effects of food and treatment, is, I think, more likely to lead to correct conclusions than too great reliance upon experiments, which manifestly must always be conducted under great doubt and uncertainty." The practical farmer, when he reads this pretty correct statement, will not fail to bear in mind, that even these extended practical observations are, in truth, merely the results of a series of experiments; and that, although the more scientific trials of such men as Boussingault and Dr. Thomson do not absolutely decide the questions to which they relate, yet they will serve as very valuable steps towards more extended, and consequently more decisive investigations. The paper of Professor Thomson, on "The Nutrition of Animals," appeared not long since, in the "Philosophical Magazine and Journal," and an abridgement of this mode, with great care, will be found in the volume for 1849 of the "Scottish Agricultural Journal." This experiment of the great German farmer and chemist is thus described:—

"On the farm of Boussingault, at Bechelbronn, in order to ascertain the quantity of milk produced, seven cows were subjected to an accurate series of experiments extending over a whole year. They received daily thirty pounds of hay, or of those roots similar in composition, and yielded, together, 8788 maass (3837 quarts). The time during which they supplied milk was 302½ days. This gives as a mean 4.1 maass (1.8 qt.) daily for each cow. But the quantity of milk varies very much; for in the months of July and August they yielded above 6 maass (2.64 qts.), while in February and March they gave only about 2½ maass (1.1 qt.). From observations of a similar nature, made, however, upon only one cow, the average daily quantity of milk yielded was 3.7 maass (1.63 qt.) If we take 2½ maass (1.097 qt.) as the lowest quantity, and 7 maass (3.073 qts.) as the highest, we get daily, for one cow from 10.3 lb. to 29 lb. of milk, which contain—

4.69 oz. troy	to	13.04 oz. butter.
7.08 ..	..	23.02 oz. sugar of milk and sol. salts.
7.88 ..	..	22.18 oz. caseine and insol. salts.
Total 19.65 ..	..	58.24 oz. solid matter.

"In reference to the influence which the food has upon the quantity of milk, all farmers know that cows give most milk with green food, and less with hay, &c. In other respects the influence of the food is not so great as might be expected. Boussingault and Le Bel agree upon this point, at least so far

as concerns the quantity of milk. Dr. R. D. Thomson, on the contrary, draws from similar and equally extensive experiments the conclusion that the quantity of milk and butter increases in proportion to the quantity of nitrogen of the food. He has drawn this conclusion from experiments upon two cows during periods of five days. His results are shown in the following table, in which grass is the only exception:—

Kind of food.	Pounds of Milk.	Pounds of Butter.	Nitrogen in the food in 5 days, in lbs.
Grass	114	3.50	2.32
Barley and hay	107	3.43	3.89
Malt and hay	102	3.20	3.34
Barley, molasses, and hay	107	3.44	3.82
Barley, linseed, and hay	108	3.48	4.14
Beans and hay	108	3.72	5.27

"Another table gives the average quantity of solid constituents of the milk obtained for periods of five days.

	Grass.	Barley entire.	Malt entire.	Barley crushed.	Malt crushed.	Barley & Molasses.	Barley & Linseed.	Beans.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Milk....	29.64	25.57	24.82	28.12	26.61	26.96	24.48	2.70
Butter ..	5.96	5.56	6.56	6.87	6.43	7.00	7.00	7.5

The milk consists of—water, 87.19; butter, 3.70; sugar, 4.35; caseine, 4.16; sol. salts, 0.15; insol. salts, 0.44. The constituents of the butter are—oil, 86.3; caseine, 0.9; water, 12.8. The fact that not merely the quantity of milk, but also that of the butter, increases with the amount of nitrogenous matter in the food (that is, with the proportion of plastic nourishment), is worthy of notice; for, from the absence of nitrogen in the butter, we should be apt to expect the contrary. Playfair, in his experiments, has certainly inferred this; for, according to him, those substances which do not contain nitrogen (potatoes, &c.), yield milk rich in butter, and rest (stall-feeding) acts in the same way; while, if the animal be allowed to feed on poor pasture, where it must move about a good deal, it yields milk rich in caseine. But his experiments were continued for such short periods, that important conclusions cannot be deduced from them. From Dr. Thomson's observations, we find that if a cow always receives the same kind of food, the quantity of milk gradually decreases; but if its diet be changed, it rapidly increases. A frequent change of diet is therefore advantageous. He has also established the rule, that the quantity of milk ob

tained from a cow is greater in the morning than in the evening. When fed on barley and hay, they yielded—

	Aug. 1.	Aug. 2	Aug. 3.	Aug. 4.
Morning	11½ lb. ..	11½ lb. ..	10 10-16 lb..	10 14-16 lb.
Evening	10 1-5 ..	9 11-16..	9 11-16 ..	9 11-16."

We have here a series of trials applying to the practice of the farmer the science of the chemist, which, however much they need repetition and increased information, will be regarded by my readers with the interest their great value and importance demands. The first steps in any difficult inquiry are ever uncertain, and fraught with sources of deceptive conclusions; these, however, must be dared and overcome. Such remarks, too, peculiarly apply, when we are endeavouring to disentangle the many mystic threads in which nature has here encircled her operations.

GREEN FOOD AND HAY.

No portion of the economy of food more often engages the attention of the practical farmer than the state of dryness or of moisture in which that food should be administered to animals. Some valuable experiments of a celebrated scientific continental farmer have been published upon this very question; his trials being directed to the very important branch of the inquiry as to the advantage of giving to live stock dried grass or hay, instead of giving it to them in its green state. Previous, however, to our analysis of this report, it will be well if we again briefly recur to some valuable remarks by Dr. Thomson, to which I had in a former page occasion to refer my readers, since the results of the trials of M. Boussingault illustrate the conclusion of Dr. Thomson, whilst those of the Scotch professor of chemistry point out so well the direction of the true road since followed by the excellent French farmer (*ante* p. 27). Dr. Thomson's remarks (*Parl. Paper*, 1846, No. 190, p. 70) were offered when considering the nutrition afforded to animals by hay, and its equivalent proportion of grass. He then remarked, after detailing some chemical examinations of rye-grass in various states—"From these we learn that 100 parts of hay are equivalent to 387½ parts of grass. This amount of grass should contain of matter soluble in hot water 28.13 parts, and in cold water 8-21 parts. But the equivalent quantity of hay, or 100 parts, only contain 16 instead of 28 soluble in hot water, and 5.06 instead of 8¼ parts soluble in cold water. A very large proportion of the soluble (or nutritive) matter of the grass has evidently disappeared in the conversion of the grass into hay. The result of the haymaking in this particular instance, therefore, has been to approximate the soft, tender, and juicy grass to woody matter, by washing out or decomposing its sugar and other soluble constituents. These facts enable us to ex-

plain the reason why cattle consume a larger amount of hay than is equivalent to the relative quantity of grass. Thus animals which can subsist upon 100 lb. of grass, should be able to retain the same condition by the use of 25 lb. of hay, if the latter suffered no deterioration in drying. The present series of experiments, however (referring to some valuable trials of the Professor, given in a previous portion of his report), that a cow thriving on 100 to 120 lb. of grass, required 25 lb. of hay and 9 lb. of barley or malt, thus affording collateral evidence in support of the view which we have taken of the imperfection of the process of haymaking at present in use in this country. The only method which we have found to succeed in preserving grass perfectly entire, is by drying it by means of an artificial heat. Rye-grass contains at an early period of its growth as much as 81 per cent. of water, the whole of which may be removed by subjecting the grass to a temperature considerably under that of boiling water; but even with a heat of 120 the greater portion of the water is removed, and the grass still retains its green colour, a character which appears to add greatly to the relish with which cattle consume this kind of provender. When this dried grass (as it may be termed by way of distinguishing it from hay) is examined, it will be found to consist of a series of tubes, which if placed in water will be filled with the fluid, and assume in some measure the aspect of its original condition. In this form cattle will eat it with relish, and prefer it to hay, which, in comparison, is blanched, dry, and sapless. The advantages attained by this method of making hay, or rather of preserving grass in a dry state, are sufficiently obvious. By this means all the constituents of the grass are retained in a state of integrity; the sugar, by the absence of water, is protected from undergoing decomposition; the colouring matter of the grass is little affected; while the soluble salts are not exposed to the risk of being washed out by the rains, as in the common process of haymaking."

Such is the able reasoning of Dr. Thomson on the comparative value, as food, of grass in its green and its dry state. Let us see how these sagacious conclusions are supported by the practical experiments of M. Boussingault. He tells us (*Quarterly Journal of Agriculture*, 1847, page 133)—"It is generally admitted that fodders consumed when green are much more nourishing than when they are dried; in other words, it is believed that 100 lb. of clover, lucern, or meadow-grass, have a far greater nutritive value than the hay obtained from 100 lb. of each of these elements. However, in carefully perusing what has been written on this subject, I have found nothing to justify that opinion. Indeed, two good observers, MM. Perrault and Jotemps, have ascertained that to feed sheep it will require 3 lb. 3 oz. of hay, clover, or lucern to replace 8 lb. 13 oz. of the same fodder green. Under the influence of either of these rations

there is a sufficiently satisfactory growth of wool and flesh. On the other hand, those agriculturists have practically ascertained that in the winnowing, including the fermentation in the hay-loft, and all the accidental losses, 100 lb. of clover or lucern are reduced to 23 lb. of hay. But," continues the French agriculturist, "these results do not in the least establish that the nutritive power of green fodder is diminished by the simple fact of its being dried; the physiological question is thus left untouched. For many years I made experiments to determine it. For that purpose I paid the greatest attention to the changes in the weight of 32 horses on which my researches were made, from the alternate substitutes of dry and green fodder. The results have been at one time in favour of, at another against the green diet, and upon the whole I found I was as far advanced as when I first began my experiments." After explaining that the doubtful results obtained arose, in his opinion, from the varying proportions of water in the fodder employed, M. Boussingault continues—"In order to guard against these causes of error, and to obtain comparable results, I have conducted the experiments in such a manner, that the dry fodder consumed represents precisely the hay we should obtain from the same quantity of green food; but as then it is necessary in the conduct of an experiment to continually make hay, an operation which becomes very tedious when performed on a considerable quantity of clover, I experimented on a single animal, a heifer about ten months old. The course adopted was this: The heifer was weighed when fasting. She was given a ration of green food, a little smaller than she ordinarily consumed, in order that the fodder should be entirely eaten during the 24 hours; then at the very time that the green ration was put into her manger, another exactly the same in weight and quality was selected, and immediately dried, taking every precaution to prevent the loss of the parts loosened during the drying. This dried ration was put into a bag marked No. 1. On the second day the same operation was repeated, keeping still for drying a quantity of fodder exactly equal to that to be eaten green; and that dried ration was put aside as No. 2, and so on. The heifer was then fed on green food during ten days; on the eleventh day, in the morning, she was weighed, and then was put on dry fodder. She then received successively the hay kept in bags No. 1, No. 2, &c., so that during the ten following days the heifer took exactly the same allowance, and the same quantity of food she had received during the ten preceding days; the only difference between the two diets being that arising from the presence or the absence of water in the plants. At the end of the dry feeding the animal was weighed. The whole experiment then lasted 20 days. Three series of trials were made in the first series. The heifer weighed at the commencement 5 cwt. 36 lb. 4 oz.

Days.	Green Clover consumed. lb.	oz.	Days.	Dried Clover consumed. lb.	oz.
1 ..	71	12	11 ..	16	0
2 ..	60	11	12 ..	15	1
3 ..	44	3	13 ..	16	5
4 ..	55	3	14 ..	21	11
5 ..	53	0	15 ..	17	8
6 ..	49	11	16 ..	16	7
7 ..	44	3	17 ..	16	10
8 ..	44	3	18 ..	16	10
9 ..	49	11	19 ..	14	1
10 ..	48	9	20 ..	13	15
Total during ten days.	521	2	Total during ten days.	164	4

On the eleventh day, when fasting, the heifer weighed 5 cwt. 29 lb. 10 oz.; on the twenty-first day, when fasting, 5 cwt. 40 lb. 8 oz. So that she lost 6 lb. 10 oz. during the time she fed on the green diet, and gained 10 lb. 14 oz. when dieted on the dry. Such, then, was the result of the first series of 20 days' trial. In the second series of 20 days, 10 days on green and 10 days on dry food, the following were the results :—

	Cwt.	lb.	oz.
Original weight of heifer..	6	3	12
After the green diet	5	104	11
Loss during green diet....	0	11	1
After the dry diet	6	8	3
Gain during the dry diet ..	0	15	8

In the third series of 20 days conducted in the same way—

	Cwt.	lb.	oz.
Original weight of heifer..	6	54	9
After green diet.....	6	63	6
Gain during green diet....	0	8	13
After dry diet	6	86	9
Gain during dry diet.....	0	23	3 "

In the conclusion, then, as arrived at by M. Boussingault, I am inclined to agree (and still more so with that of the editor of the valuable *Quarterly Journal of Agriculture*, that it would have been well if these trials had been *longer*), when he remarks, "the ascertained gains, in consequence of the substitution of the dry for the green rations, have been, during these trials, 10 lb. 14 oz., 15 lb. 8 oz., 23 lb. 3 oz.; results that might allow us to presume that the same quantity of fodder, when dry, is more nutritive; but from so few experiments it would be premature to draw such a conclusion. What these experiments seem to

tablish with some certainty is, that a given weight of dry fodder is not less profitable for feeding than the quantity of green fodder which it is derived from." I need hardly commend these important researches to the careful study of the English stockholder. Too little attention may hitherto have been paid to these matters, and if so, then every little advance in this way becomes a highly valuable step in the right direction.

NECESSITY FOR A CERTAIN BULK OF FOOD.

In our recent observations on the feeding of live stock, we have had occasion to notice, incidentally, the advantages of a mixture of food. It may be useful to many of my readers if we pursue this portion of the investigation more in detail, and endeavour to see our way a little more clearly in this important practical inquiry. Before we look to the result of our experience on this head, or that of other practical farmers, it may be well to examine one or two of the explanatory observations of men of science on the subject. "In the rearing of young animals of all descriptions," remarks Mr. Karkeek, an eminent Cornish veterinary surgeon (*Jour. R. A. S.*, vol. v., p. 262), "it must be evident that substances rich in nitrogen are particularly required for the growth of the various parts of the body, since there is no part of an organ that contains less than 17 per cent. For the growth of bone, muscle, blood, membranes, skin, horn, hair, and cellular tissue, a certain amount of this substance is absolutely necessary. In the rearing of horses, where the object is to produce a great development of muscle, this is particularly required; hence it is the practice of intelligent breeders to supply the young stock with a proper allowance of oats, peas, beans, and shelter during the winter; and it is from the want of these requisites that so many thousands of horses are rendered worthless." The observation of Mr. Karkeek is confined to the chemical composition of the food, and its effect in the production of muscle; but the advantages of mixing food are not confined to these and other chemical advantages. There are mechanical advantages, as well as chemical good effects, produced by the mixture of certain food, such as straw and hay, or chaff, with better and more concentrated food, advantages which are described by Professor Lyon Playfair (*Journal R. A. S.*, vol. iv., p. 235), when he observes—"I am quite aware many farmers entertain the opinion that cutting hay is only of use in the facilities which it affords for mixing with the hay, straw or other inferior fodder. Straw, except when new, is not a very nutritious food, for we find a great part of it unchanged in the fæces of the animal fed upon it. Its principal use is to give a bulk to the food taken. Even in the case of turnips, a food of considerable bulk, straw is necessary, because they contain nearly 90 per cent. of water, which becomes soon separated. Thus it is that cattle fed upon turnips voluntarily take 2 lb. or

3 lb. of straw daily, or as much as will serve to give the necessary bulk to the food. The digestive process of herbivorous animals is very complicated. The food is primarily taken into the first stomach or rumen, which is analogous to the crop in birds. Here it is moistened with a secretion from the stomach. The coarse unmasticated food is from thence transmitted into the second stomach, or reticulum, where it is rolled up into little balls, one of which from time to time is returned to the mouth to be further comminuted and insalivated. After this reduction, it is sent into the manyplus or third stomach, where it is further reduced to a pulpy mass, and in this state enters the fourth stomach, where true digestion commences. The object of the three first stomachs being merely to obtain a proper comminution of the food, it is necessary to have that food of sufficient bulk, otherwise the peristallic motion of the stomach would be impeded. This would appear to be the reason for giving straw with turnips and other kinds of succulent food. The expression of the farmer is 'that straw corrects their watery nature,' which means, increases their bulk when their water has left them and reduced their volume. Rumination is requisite in order to keep a cow in health. A little straw or hay is accordingly necessary to enable it to chew the cud. We know a case in which barley-meal and boiled potatoes were given to cows without hay or straw. Constipation resulted, and the cattle nearly perished from the ignorance of the feeder. From these considerations we are induced to consider that a greater return will be made by food partly, but not too much, reduced. The turnip-slicer is known to save food, and this arises from the fact that the sheep expend less force in eating sliced than whole turnips, and to their being enabled to lie down more constantly. On similar grounds are we to ascribe the advantage of steaming food, or reducing it to the state which the first three stomachs would otherwise have to do at a great expenditure of force, and consequently of food to produce it."

That such researches into the effect of various foods are sure to be productive of benefit, no one to whom I address myself will feel disposed to deny. No person ever conducts any profession less successfully, because he understands it thoroughly. It is one thing to try unmeaning experiments (and even they are not always unproductive of benefit), but it is another to attempt such as those on which I have in this little section been engaged, which tend to economise the consumption of the food of animals, or to produce that food at a diminished expense. The first class of chance trials are commonly those adopted by persons who rely upon "good luck;" the last description are those of such who, with a firm reliance upon Providence, do not forget that his blessing will ever attend the laborious, prudent, and energetic farmer.

THE FOOD OF MILCH COWS.

Some approximation to the average amount of food required for a cow may be made by calculation. The relative value, too, of different kinds of food needed, may be estimated by the following table by the late Rev. W. Rham, of Winkfield (*Jour. R. A. S.*, vol. iii., p. 79). A milch cow requires about 3 per cent. of her weight per day to keep her in health; a fatting ox 5 per cent. at first, 4½ per cent. when half fat, and only 4 per cent. when fat, or 4½ per cent. on the average. In Holstein (*ibid*, vol. i., p. 384) the winter allowance of sheltered or shed fed cows, is three sacks of grain (generally oats of 140 lbs. each sack), 3,900 lbs. of straw, including bedding, and 1,800 lbs. of good hay; whilst for every 100 lbs. of hay less, she must receive 25 lbs. of grain more. The following table gives the mean results of the trials of various continental scientific farmers, on the comparative value of different kinds of fodder:—

	lbs.
100 lbs. of good hay is equal in nourishment to	100
Lattermath hay	102
Clover hay, made when the blossom is completely developed	90
Ditto, before the blossom expands	80
Lucerne hay	98
Sainfoin hay	89
Tare hay	91
Spergula arvensis, dried	90
Clover hay, after the seed	146
Green clover	410
Vetches, or tares green	457
Green Indian corn	275
Green spergula	425
Cow-cabbage leaves	541
Beet-root leaves	600
Potato haulm	300
Wheat straw	374
Rye straw	442
Oat straw	195
Peas haulm	153
Vetch haulm	159
Bean haulm	140
Buckwheat straw	195
Dried stalks of Indian corn	400
Millet straw	250
Raw potatoes	201
Boiled ditto	175
White Silesian beet	220
Mangold-wurtzel	339
Turnips	504
Carrots	276
Kohlrabi	287
Swedish turnips	308
Ditto, with the leaves on.	350
Grain of rye	54
—— wheat	45
—— barley	54
—— oats	59
—— vetches	50
—— peas	45
—— beans	45
—— buckwheat	64
—— Indian corn	57
—— French beans dried.	32
—— chestnuts	47
—— acorns	68
—— horse chestnuts	50
—— sunflower seed	62
Linseed cake	69
Wheat bran	105
Rye bran	109
Wheat, peas, and oat chaff	167
Rye and barley chaff	179

The following table of the chemical composition of various

articles of food, may, as Mr. Karkeek remarks (*Jour. R. A. S.*, vol. v., p. 249) prove serviceable, by enabling us to trace the sources from which are derived particular organic compounds essential to nutrition. Thus the proportion of starch, gum, and sugar, contained in any separate article of food, will enable us to form a rough approximation as to the per centage of *fat* or *tallow* which it is capable of yielding; and the number representing the *gluten, albumen,* and *caseine,* in the same article of food, will give us a very correct indication of its muscle of flesh-forming principle. In the mill, 14 lbs. of good wheat yield, on an average, 13 lbs. of flour; the same quantity of barley, 12 lbs.; and of oats, only 8 lbs. *(For Brewers' Grains, see post.* 110.*)*

100 parts of	Water.	Husk, or woody fibre.	Starch, gum, and sugar.	Gluten, albumen, and caseine.	Fatty matter.	Saline matter.
Field beans ..	16.0	10.0	40.0	28.0	2.0	3.0
Peas	13.0	8.0	50.0	24.6	2.8	2.8
Barley	16.0	15.0	60.0	12.0	2.5	2.0
Oats	16.0	20.0	50.0	14.5	2.6	3.5
Meadow hay..	14.0	30.0	40.0	7.1	2. to 5.	5. to 10.
Clover hay ..	14.9	25.0	40.0	9.3	3.0	9.0
Potatoes	75.0	5.0	12.0	2.25	0.3	0.8 to 1
Carrots	85.0	3.0	10.0	2.0	0.4	1.0
Turnips.....	85.0	5.0	10.0	1.2	—	0.8 to 1
Oat straw	12.0	45.0	35.0	1.3	0.8	6.0
Wheat straw..	12. to 15	50.0	30.0	1.3	0.5	5.0

Carrots, parsnips, mangold-wurtzel, and turnips (all previously cut into small pieces), are excellent food for milch cows.

Various means have been suggested to prevent the unpleasant flavour possessed by the butter from turnip-fed cows. Thus it has been found that it is beneficial to let the cow have her turnips only directly after being milked, as she has thus twelve hours to get rid of the flavour. Steamed turnips are said to be less objectionable in this way; and that stale pieces of turnip should be always removed from the manger. Saltpetre added to the cream, in the proportion of ¼ oz. to two gallons, has been thought to remove the flavour.

PARSNIPS.

Some attempts have lately been made to induce the more general cultivation of parsnips as the food of cows. The root has also been urged upon the attention of the little Irish cultivators, as a partial substitute at least for the now uncertain and far too generally cultivated potato. The parsnip is a root full of nutriment, and has long been grown in the Isle of Jersey as a field crop. Colonel Le Couteur some years since described its cultivation in that island (*Jour. R. A. S.*, vol. i., p. 421). He

tells us that the average crop per acre may be from nine to eleven tons. One crop, which had on the previous year been offered in competition for a prize, was found on small plots to produce at the rate per acre of 27 tons 8 cwt.—a quantity nearly sufficient for ten cows (adds the Colonel) during the six winter months, according to the calculation of the Flemish farmers, and more than enough for twelve Jersey cows in my estimation, together with straw, hay, and a few mangold-wurtzel, or turnips; it being known, he pretty correctly adds, to all, that cattle will not thrive on one kind of food. The composition of the parsnip has been given on the authority of three analyses, which examinations, however, are deemed by Professor Johnston to be imperfect (*Quar. Jour. Ag.*, 1847, p. 608):—

	Carrot.	Sugar Beet.	Parsnip.
Water.....	80.00	85.0	79.4
Starch and fibre....	9.00	3.0	6.9
Gum	1.75	2.0	6.1
Sugar.....	7.08	10.0	5.5
Oil	0.35	—	—
Albumen	1.01	—	2.1

The parsnip has evidently been cultivated in some parts of Ireland with much success. Writing in the month of March, 1849, Mr. Charles Beamish *(Cork Constitution)* thus sums up the results of his experience in its cultivation:—

"Influenced by those who recommend the sowing of parsnip seed in the autumn, I sowed some in October last. It came up well, but the growth off the little plants being stopped by the cold of the winter, the larks, linnets, and other small birds have completely eaten them of the face of the field, and the ground is now in preparation for re-sowing. Too little consideration is in general given to the warfare of birds and insects with which farmers have to contend in the cultivation of their crops, and the result obtained by a person carefully directing and protecting the process of an experiment, is often found impossible to be realized in the practical working of the extensive operations of the open fields. Considering the great depth (three feet in favourable subsoils) whence the parsnip raises up, as it were from a mine, by its tap root, the materials from which the most valuable ingredients may be obtained (through the digestion of animals) for restoring to the soil the elements required for the growth of plants, I am disposed to recommend this root particularly to the immediate attention of your readers, and must not therefore forget to mention the following other advantages in its favour, in addition to those stated, viz.:—1st. Milch cows fed on it give the richest milk, of the best flavour; those of Jersey and Guernsey, wintered on parsnips and hay, yielding butter of as fine a tinge, and nearly as good a flavour as when fed in pastures. 2nd. Horses thrive on it as well as on the car-

rot. 3rd. It yields much spirits by distillation. 4th. All poultry eat it readily when boiled: and 5th. Though potatoes, carrots, and turnips are all stolen from us with little compunction, I am not as yet aware of having any co-partners in the consumption of my parsnips."

"The parsnip," correctly remarks Colonel Le Couteur, in another place, "will thrive in any deep land, whether stiff or light; it succeeds in Jersey admirably, on soil resting on granite or sienite, on argillaceous schistus or red clay, or on a gravelly bottom, on almost pure sand if mixed with a light coating of earth, and on soils derived from pudding-stone, or white and red felspar. This includes most of the soils of the British islands, exclusive of the chalky or limestone ranges. It may be added, that some cultivate this plant on poor black heath soil, not above seven or eight inches deep, and by means of heavy dressings of manure raise a good crop; but the parsnip in such situations forms a large shoulder, and forks away into fingers, when near the hard subsoil; whereas, in very deep land, it will run down a foot or two, of a good size, and sometimes appear with a long whip-thong, as it were, to its thick handle. An old grass ley is broken up by some persons in September, by others just before the parsnip seed is sown. The former I consider the best mode. When the turf is well rotted, 20 tons of stable manure per acre is spread over the land. A trench is then opened through the centre of the field, between two and three feet wide, and, where the soil will admit of it, from one foot to eighteen inches deep. A small two-horse plough then turns the manure and about three inches of soil into the trench, and is immediately followed by a large trench-plough with three or four, and in many cases here with eight or ten horses, which turns a foot or more of clean soil upon the manure and scurf, when the land has been recently skim-ploughed. The soil is then harrowed, and the parsnip seed, which should be new, is sown at the rate of three or four pounds to the acre, and lightly harrowed. When the plants are an inch high they are to be weeded—this was formerly contracted for at the high price of £2 5s. per acre—to be repeated thrice by hand in the season, and to leave them without a weed; but this extravagant mode has given place to hoeing, which can be done at less than half the cost, and is probably more beneficial, as it stirs the land deeper. In Guernsey a still more expensive mode is adopted, that of weeding with a hand hoe, having a straight blade of iron, eight inches long, four or five inches wide at its edge, narrowing upwards to a short handle a foot long, with an elbow to it nearly at right angles; the blade is pressed into the earth, and the crooked handle affords a leverage which enables the person to stir it effectually, and destroy every weed. This is mentioned incidentally, as it is too slow a mode for the rapid principle which has now obtained in all things; however, it may be a question whether a greater crop was ever

raised by other means than one produced in the ordinary way, which I shall presently mention. The plants from the first are to be thinned out to six inches apart, and according to the soil, should be again thinned out to nine inches or more at the second hoeing. In September, when the fine aftermath begins to appear, some of this crop may be taken up for milch cows, as from twelve to twenty-five pounds of them, given at milking time, will have a surprising effect on the cream, and produce fine yellow butter, which will keep admirably if properly salted and prepared, preserving an excellent and superior flavour."

There are several properties then of the parsnip which would induce its extended cultivation I think on many soils, if its value was better understood. One great error which has too often retarded its proper estimation as a field crop is its attempted cultivation on soils too shallow, and on which no attempts had been previously made to deepen it, by either the plough or the fork. I have often in the case of carrots witnessed the powerful effect produced by the application of soot and salt mixed together as a manure; and some trials on parsnips, which we not long since instituted, lead us to conclude that a similar benefit may be derived by the same mixture being ploughed or trenched into the land preparing for parsnips. The soil in which the parsnip best succeeds is a deep, dry, sandy loam. It flourishes most on gravel or on clay. The gardener is well aware that the deeper the soil is disturbed the better it is adapted for parsnips. He is used therefore to trench such soils two spits deep, and he is well aware of the advantage of trenching in a little manure with the bottom spit. If, however, the soil is in good heart, and adapted to the growth of this crop, the application of manure just before the seed is of little value, since it induces numerous fibres. In the Island of Guernsey, which is celebrated for its parsnips, seaweed is extensively employed as a manure. It has been long observed that pigeons' dung is an excellent dressing for parsnips, and this fact would seem to indicate that guano would also be materially serviceable as a dressing for this crop. Some discussion has taken place as to the best time for sowing the seed. This, as with most other crops, is to be decided by the nature of the soil. Such a rule is, in fact, adopted by the generality of cultivators. In the soils the best adapted for its growth, they sow in January; in wetter and more tenacious soils, they defer this even until the end of March. It has been noted in garden cultivation, that the parsnips sown in September attain a finer flavour than the latter sown; but then they are much more apt to run to seed. In the choice of seed, that of the previous year should be secured, as after that it loses its vegetative power. The root is hardy, not much subject to the attacks of insects, and when cultivated on a suitable soil, yields a large produce of food for live stock. It is therefore a crop which, in many places, might be introduced, to a certain extent, with very considerable

advantage. It is eaten by cows with avidity, is very nourishing, and, as we have seen, well adapted for the food of milch cows. They are also considered by the farmers of the Channel Islands to be excellent food for pigs, and to render their flesh delicately white. It produces, too, the best beef, for the parsnip-fed meat always obtains in Jersey the highest price. These careful cultivators, however, object to the use of the parsnip leaves for cows, since they impart rather a disagreeable taste to the milk. They also pretty generally agree that they are not so well adapted as the carrot for horses.

THE VALUE OF SALT FOR COWS.

Nature has pointed out, in very intelligible language, the value of common salt for some of the farmers' domestic animals. For instance, the wild cattle of India are well known to be remarkably fond of salt; and the natives take advantage of this circumstance to tame them. They for this purpose employ balls composed of a particular kind of earth, salt, and cotton, which, according to Mr. Lambert, they are so fond of licking, that they never leave the place while any of it remains (*Annual Review*, 1804, p. 767). The cattle in the neighbourhood of the salt springs of Vich at certain seasons of the year seek these waters. The rein-deer of Lapland are equally impelled at particular periods of the year to the sea-water; and in many of the warmer countries of the west, the domestic cattle cannot exist without salt. The owners of the great Spanish merino flocks constantly give them salt; and it has been used of late years pretty generally for the sheep of our own country. The effect of using salt is to produce, in general, an increase of appetite, improved digestion, and general good health. The proportion in which it has been given to stock varies in amount; it seems that, in those cases where it is possible to allow the live stock to help themselves, such a mode is better than by giving it to them by regular measure or weight. In Spain, where it is regularly given to the Merino flocks, 1,000 sheep consumed in five months about 112lb. of salt. The late Mr. Curwen, for several years, gave his live stock salt in their food. Each horse had 6 oz. per day; milch cows, 4 oz.; feeding oxen, 6 oz.; yearlings, 3 oz.; calves, 1 oz.; sheep, 2 to 4 oz. per week. These were the proportions given to them when they were feeding upon dry pastures; but if they were feeding on turnips or coles, then they were allowed salt without stint. That the use of salt is found to render live stock less liable to disease, is an old and increasing conviction. Its use has been deemed by many flockmasters very useful in saving sheep from the attacks of the rot; and in a valuable letter of Mr. R. Smith, of Upper Hall, near Droitwich (*Farmers' Mag.*, vol. for 1841, p. 255), he gave some valuable information as to his belief in its power of preventing the attack of the epidemic of 1841. He observes: "M

stock having escaped the prevailing epidemic that has been general in this neighbourhood for the last six months, not a single case having occurred among a considerable quantity of horses, cattle, and sheep, although grazing in fields adjoining to where diseased stock was depastured, separated by hedges only, and also adjoining a turnpike-road, where stock afflicted with the complaint were constantly travelling, I shall therefore give to the public my impression of the reasons I conceive that exemption is owing to, hoping that others may benefit from the same practice, should my opinion prove correct. The practice alluded to is to place plenty of salt within reach of every species of stock, so that they may at all times have it in their power to gratify their appetite for this condiment, of which they are very fond, and consume some quantity, particularly stock that have been accustomed to it; for, on putting them into a fresh pasture or yard, where there is no salt, on returning to the field or place where they have been used to find it (even after some time has elapsed) they will immediately make for the spot in search of it. I am aware that salt is strongly recommended by many writers on agriculture, but is not so generally used as it deserves; one reason may be the difficulty of keeping up a supply where it is exposed to the atmosphere, as in damp weather it dissolves quickly, and often requires to be renewed. The best salt for stock (which I make use of) is called at the works *pickings*; it is in flat pieces, varying from one inch to two inches and a-half in thickness, extremely hard and pure; it is an incrustation from the brine adhering to the bottom of the pan or boiler in which the brine is evaporated, requiring great labour to separate it from the pan with sharp mattocks; it is usually ground between rollers by steam power, and is then called agricultural salt, and is used to a considerable extent on the light, blowing sands, for turnips and clover. These cakes or pickings will remain undissolved, when exposed to the weather, for a length of time, from the hardness and fineness of the grain, which gives it the appearance of marble when licked by the stock. The best way is to place it in small stone troughs, in conspicuous parts of the fields, also in yards, stable-mangers, and feeding-stalls. The price I give for it at Droitwich is 5s. per ton, which quantity will supply a great stock for many months. I think it right to add that the situation of my farm is high and exposed to the winds, the pastures being large and open. This may in some degree secure the stock from infection; but, as I have stated before, they were contiguous to a public road, and also to infected stock. I can, therefore, only account for my perfect exemption from the disease in the liberal use of salt.

The mode in which salt acts as a condiment for the farmers' live stock has been explained by M. Liebig, in his recent work, "*Researches on the Chemistry of Food*," p. 110. "An animal," he remarks, "feeding on plants which contain phosphates of

other bases, along with some compound of soda or sodium, produces in its body the phosphate of soda indispensable to the formation of its blood. But an animal living inland obtains in the seeds, herbs, roots, and tubers which it consumes, only salts of potash. It can procure from the phosphates of lime and magnesia, by decomposition with the salts of potash, only phosphate of potash, the chief inorganic constituent of its *flesh*; but no phosphate of soda, which is a compound never absent in its blood.

"Whence, therefore, does it obtain this phosphate of soda? It is obvious that phosphate of potash is decomposed when in contact with chloride of sodium; part of the potassium combines with the chlorine, while the sodium replaces it in the phosphate, phosphate of soda being produced. In this way we can understand the formation of phosphate of soda in the body of an animal, which obtains in its food, along with phosphate of potash or earthy phosphate and salts of potash, no compound of soda, except chloride of sodium (common salt); and when, in inland countries, the food does not contain common salt enough to produce the phosphate of soda necessary for the formation of the blood, then more salt must be added to the food." There appears to be an unrestrainable instinct in the animal, which prompts it to seek for salt. It is true, the proportion in which they consume it is not large, nor should we expect, from Liebig's explanation of its mode of action, that it would be considerable; but still the sheep, for instance, when feeding on certain food, is always eager for it. The late Arthur Young noticed this in his evidence before the Salt Committee of 1818, when he observed (*Minutes*, p. 18): "Feeding the sheep with the salt, with my own hands, I found them so ravenously fond of it, that the moment they saw me at the gate of the field, they came up from every part. The quantity, however, which they took was a perfect contrast apparently to the extreme eagerness with which they came. They took a good lick at it, and went away; but they were exceedingly eager to get that lick." It is also noticeable that the farmers who give salt to their live stock have remarked that they consume more salt in inland places, when feeding upon grass or hay, than when fed with mangold-wurtzel or turnips. Now this is explained by the fact that common salt exists, if at all, in very small proportions in the corn with which stock are commonly fed, in the grasses, or in hay; whilst, on the other hand, it is found in very considerable proportions in the roots to which we have alluded. Thus, in the *saline produce* of an acre of peas and of beans, Professor Way found, in pounds (*Johnson and Shaw's Farmers' Almanac*, 1848, p. 23), calculating the pea and bean-seeds to be each one ton, the pea-straw 2,989lb., the bean-straw 2,270lb., all being grown on clay soil:

	Peas.	Beans.	P. straw.	B. straw.
Silica	0.42	0.22	4.62	2.95
Phosphoric acid..	14.43	15.23	2.93	0.55
Sulphuric acid ..	2.93	1.62	5.38	1.58
Lime	2.28	2.75	86.80	22.25
Magnesia	3.48	3.66	13.62	2.85
Perox. of iron....	—	—	1.74	0.69
Potash	20.75	27.40	80.18	36.96
Soda	2.51	0.28	0.57	3.13
Common salt	2.15	—	23.00	13.88

And Professor Johnstone found in 1,000lb. of the hay of red clover, lucern, and sainfoin, and 1,000lb. of potatoes:

	Clover.	Lucern.	Sainfoin.	Potato.
Silica	3.60	3.30	5.00	0.84
Potash.....	19.95	13.40	4.37	40.28
Soda	5.29	5.79	6.15	23.34
Lime	27.80	48.31	21.95	3.31
Magnesia.....	3.33	3.05	3.48	3.34
Alumina.....	0.14	0.30	0.66	0.50
Oxide of iron....	—	0.30	—	0.32
Sulphuric acid ..	4.47	4.04	3.41	5.40
Phosphoric acid..	6.57	13.07	9.16	4.01
Chlorine.....	3.62	3.18	1.57	1.60

The average analysis of one ton of the entire plant of the crops to which I have referred, however—bulbs and tops—yielded Professor Way (*ibid*, p. 11) the following large proportion of common salt:

	Turnip.	Mangold.	Carrot.
Silica	0.55	0.56	1.23
Phosphoric acid..	1.90	0.87	1.63
Sulphuric acid ..	2.51	0.90	2.37
Lime	3.76	0.87	8.21
Magnesia	0.59	0.89	1.19
Peroxide of iron	0.18	0.15	0.73
Potash	5.84	5.54	5.60
Soda	1.38	2.91	4.33
Common salt....	2.37	6.51	3.53
Chloride potassa	0.53	—	—

The animal, therefore, when feeding upon these roots, is supplied in their substance with nearly, if not quite, a sufficient proportion of salt for all its requirements; nature does not prompt it to take more. But when it is supported on other food, in which salt only exists in very small proportions, then it is that it seeks an enlarged supply from other sources. Let us, then, not neglect these instructive indications of nature. In all

our researches we can never seek for a safer and a more certain guide. If her replies are not always intelligible to us, we may be assured that it is we who are ignorant, and not nature who is working by laws uncertain or unmeaning.

THE FOOD OF THE FATTENING COW.

My observations upon the food of the cow have been hitherto chiefly confined to her food when giving milk. Another portion of her existence is when she is fattening for the butcher. Here we have another state of things. We cease to require of her milk; we now require flesh and fat in its place. Here the requisites are quiet, warmth, and good and regular feeding. She will now bear an increased supply of food; and various kinds of that food may now be given, such as turnips and linseed-cake, which, when milk only was our object, were objectionable, from either their imparting a taste to the milk or for some other cause.

LINSEED CAKE.

To almost every person who uses linseed-cake for his cattle, the question is pretty certain sooner or later to present itself—"If the oil-cake is so nutritious, is not the linseed from whence the cake is obtained still more profitably so?" Or, as Mr. George Nicholl puts the case (*Jour. R. A. S.*, vol. viii., p. 466), if the oil-cake is found so very valuable for feeding purposes, we can hardly doubt that the linseed itself will be more so, the cake consisting of little more than the husks after the oil has been expressed—that is, after the most nourishing portion of the seed has been abstracted; yet this refuse is found highly nutritious for cattle, which fatten on it very rapidly. It has indeed been doubted whether the cake will not answer better than the seed, on account of the latter being so rich as to be apt to disagree with the cattle, if given in any quantity, the oil possessing strong purgative powers. The plan advocated, and recommended by the practice of Mr. Warnes, of Trimingham, obviates this objection, for it is in that way reduced to a state of mucilage, and mingled with other substances. Food may no doubt be too rich for cattle as well as for man, and bulk is necessary as well as nourishment in what is taken into the stomach; but wherever there is an excess of nourishing properties how easy is the remedy. We have only to dilute by mixing other materials less rich, less nourishing. In the instance to which we have referred ground linseed, in the shape of mucilage, is to be mixed with other substances, the produce of the farm, viz., grass, clover, hay, or pea and bean haulm cut into chaff, or the chaff of corn and flax, or barley, pea, and bean-meal, or turnip, mangold wurtzel, carrots, cabbages, and potatoes, boiled or steamed. These materials, compounded with the linseed, give bulk and substance as well as variety, and thus become the medium for

imparting the largest amount of nourishment in a form most agreeable, most conducive to the animal's health, and best calculated to ensure its speedy fattening. It is always very desirable, if we can, to base our inquiries upon the results of careful chemical investigation, which we are fortunately in this case enabled to do, thanks to the indefatigable labours of Professor Johnston (*Trans. High. Soc.*, 1846, p. 202). He found in 100 parts of English linseed-cake—

Water	10.05
Mucilage	39.10
Albumen and gluten ..	22.14
Oil	11.93
Husk	9.58
Ash	7.25

Let us compare this with the results of his other investigations on the common food of live stock, which he has given in another place (*Johnson and Shaw's Farmers' Almanac*, vol. iii., p. 99), from which we learn that 100 parts of the following substances contain—

	Starch, Gum, and Sugar.	Gluten, Albumen, and Caseine.	Oil.
Indian corn ..	70	12	5 to 9
Oats	65	18	5 8
Barley	60	12	2½ 0
Rye	60	14⅓	1 0
Wheat flour ..	55	15	2 4
Peas	50	24	2½ 3
Beans	40	28	2⅓ 3
Potatoes	12	2⅓	0¼ 0
Turnips.....	10	1¼	0¼ 0

As the Professor remarks, these analyses are interesting in several respects; they show that the per centage of proteine compounds, here called gluten and albumen, is nearly equal to what is contained in peas and beans, and that therefore for the production of milk for the cheese dairy, and for laying on muscle, oilcakes are as valuable as beans, peas, or clovers. This is a result somewhat unexpected, inasmuch as the value of oilcakes in the feeding of stock has hitherto been supposed to depend very much upon their power of laying on fat; in other words, upon the per centage of oil they contain. The proportion of oil remaining in these cakes is greater than is naturally present in any species of grain or pulse usually cultivated as food for animals. Oats contain at a maximum about 7, and Indian corn about 9 per cent. of oil, but these cakes contain 12 per cent., and are therefore in their ability to supply fat to an animal superior to any of our cultivated grains. The analysis of the ash of linseed-cake produced some very noticeable results, not only

in the feeding of live stock, but in the growth of linseed. 100 parts contained—

Alkaline salts	31.55
Phosphates of lime and magnesia	47.67
Lime	4.88
Magnesia	1.51
Silica	10.81
Sand	3.86

The Professor suggests the following very interesting practical observations:—1. These oilcakes leave six per cent. of ash, of which one-third consists of phosphoric acid; 100lbs. of oilcake, therefore, contain 2lbs. of phosphoric acid. On the other hand, our common kinds of corn—wheat, for example—leave only 2 per cent. of ash, of which one-half consists of phosphoric acid, or 100lbs. of wheat contains 1lb. of phosphoric acid. Therefore for laying on bone, or for supplying the materials of bone to growing stock, oilcake is twice as valuable as wheat, weight for weight, and more than twice as valuable as oats or barley, which are covered with a husk. Again, the same reasoning shows us that as grains of all kinds draw their phosphoric acid from the soil, these oily seeds will exhaust the soil of its phosphates to a much greater degree than our corn crops; 100lbs. of linseed will carry off twice as much of them from the soil as 100lbs. of wheat. But the same circumstance supplies us with an additional reason why the manure of full grown store stock fed upon oilcake is so much richer than that obtained by the use of any other kind of food. It is richer, because, as we have seen, the proportion of the protein compounds (albumen, &c.,) in the oilcake is greater than the fattening animal can appropriate, and thus much of them passes off in a more or less changed state, and is mixed with the dung. The oil also is in larger proportion than can at times be laid on their bodies even by fattening stock, and this unquestionably contributes to the fertilizing quality of the manure. But the full grown animal appropriates scarcely anything of the phosphates, and the whole, therefore, of those which the animal consumes in its food appears again in its dung; and as we have seen, the oilcakes being richer in these phosphates, weight for weight, than any kind of corn we use for food, the dung thus made is also richer in these phosphates than that which is obtained from animals fed upon almost any other kind of food.

In reference to the remark of the Professor as to the non-appropriation of some of the constituents of the oilcake by the fattening animal, we may refer to the very distinct flavour of the linseed oil which the beef of cake-fed animals very often posseses; and we have from several authorities understood that in the case of pigs which have been fed with a proportion of oilcake, the flavour which it imparts to the pork is retained for a

very considerable period, and with such tenacity, in fact, as to be hardly capable of being removed by any other course of feeding. Another very important branch of the inquiry consists as to the asserted possibility of finding a substitute of other compounds for linseed cake in feeding stock. On this hand Professor Johnston remarks, the oilcake contains from 22 to 25 per cent. of protein compounds (albumen, gluten, &c.) In this respect, the pea and the bean are the only seeds that approach to it—the pea containing 24 and the bean sometimes as much as 28 per cent. of such protein compounds. The bean, therefore, is the only other vegetable food we possess which can be made the basis of an artificial imitation of the cake from oily seeds. The next peculiarity in the oilcake is the large proportion of fatty matter they still contain. In the best English and foreign cakes the unextracted oil appears to amount to nearly 12 per cent. This also is greater than any other food usually given to our cattle contains. Oil or fat in some cheap form or other must therefore be added to any mixture which is to rival oilcake. If with 90lbs. of beans we could mix, grind up, or otherwise incorporate 80lbs. of oil or fat, we should have a compound nearly equal in all but one respect to an equal weight of the cake from the natural seed. Thus 100lbs. of English oilcake and 100lbs. of beans so prepared would contain of—

	Linseed cake.	Prepared beans.
Starch, sugar, gum, and mucilage	39	40
Gluten, albumen, &c.	22	25
Fat	12	12
Ash	7	3
Water and husk	20	20

On comparing these two columns we see that the mixed beans have the advantage in regard to starch and gluten, and are defective only as regards the inorganic matter, or ash. Of this last the beans only contain one-half, and consequently are deficient in alkaline matter and in phosphates as compared with the oilcakes. The difference in composition between the ash of the bean and that of the oily seeds, so far as they have been hitherto analyzed, does not appear to be very great; the main difference being that the beans contain more alkaline matter, and the oily seeds more lime. "An addition of 6lbs. of ordinary bone-meal, recently ground," concludes the Professor, "and in a fresh and sweet state, would supply the lack of lime and phosphates, and would make a mixture equivalent in chemical composition, and therefore, I should hope, equal in fattening and other virtues, to an equal weight of oilcake." No extensive attempts, that we are aware of, have been made to produce such a compound; the trials of Mr. Joseph Marshall, of Bedale, on feeding stock with a variety of prepared food, rather led him to

the following conclusion:—"The best artificially prepared food which we have hitherto found is boiled linseed, ground corn, and cut straw, along with some raw turnips, given at intervals. A heifer weighing from 40 to 50 stones, will consume daily two pounds of crushed linseed boiled in three and a half gallons of water for two or three hours, 5lbs. of ground corn, 10lbs. of chopped straw, and about 80 or 90lbs. of yellow bullock turnips, with a little straw, not cut, placed in their racks at night. The cost of food thus prepared, from a statement which Mr. Marshall subjoins (*Jour. R. A. S.*, vol. vii., p. 392), in which no charge is made for straw and turnips, and in which ample allowance is made for coal, labour, and outlay of capital, appears to be 4s. 4d. for each head per week.

Practical observations like these are sure to command the careful attention of the English farmer; on knowledge derived from such sources he well knows all his success in farming depends, since he is well assured that although it may be pretty certain that there is rarely any direct profit to be derived from the fattening of stock, yet that by other and indirect ways, by the number of his fattening live stock, aided by artificial food, he is enabled to maintain the fertility of the land. And thus the texture of his soil is improved, its organic composition enriched, and finally, his barns better filled.

Several inquiries have recently reached me with regard to the use of linseed cake and malt in the feeding of live stock. One of these substances is of very considerable and well known importance to the farmer; the powers of the other are but little known, and of far less certain and established value. The somewhat contradictory result of the trials of the late Professor Thomson and Mr. Hudson, of Castleacre, will be fresh in the recollection of our readers. At a recent meeting of the London Farmers' Club, Mr. R. Smith, of Emmett's Grange, in Devonshire, made some valuable remarks in favour of its use in sheep feeding. He observed, with his usual good practical sense, "I have been called upon to state the result of the experiments which I have tried in the feeding of animals with malt. I tried malt in the feeding of sheep at a period when I was preparing some Leicester lambs for exhibition, and therefore, of course, did not wish to be outrivalled by any other individual. I commenced by giving the animals oats. I gave them peas, I gave them beans, I gave them oilcake, and lastly I gave them malt. In an essay which I wrote on the management of sheep, I have noticed about twenty experiments which I tried at the period when I had recourse to malt. Let me assure you of this—that malt made more mutton than any other article of food which I gave them; and what is more, after they had had malt, the animals refused to eat anything else. I have also exhibited oxen at the Smithfield Cattle Show, and I have found that when oxen had been crammed, and would eat nothing else, they would eat

malt. I gave them malt in the dry state; and taking the fair market value of oats, beans, and peas, and the fair market value of malt, I found that, value for value, the latter was the best food. I would here mention a little fact of some importance in connection with the question then under discussion. If any one had one hundred sheep, and divided them equally, and if he gave to the one-half all turnips, and to the other all malt-coombs, the one would become fat and fit for market much sooner than the other."

The question is of so much importance as connected with the proposed repeal of the malt tax, that I should be very glad if additional experimental information on this head could be afforded to us. Such practical evidence would have a very material influence upon the determination of parliament whenever this important subject is fairly mooted. The amount produced by the tax is so great that only the most powerful evidence of the loss sustained by the farmer and the public by its continuance can be expected to procure its removal.

The writers of most of the letters addressed to me on the subject of the comparative value of linseed cake, seem to forget that oilcake is used by the farmer as food for his live stock, not only for its immediate influence on their condition, but for its great and important indirect value. This was pretty clearly alluded to by Mr. R. W. Corringham, in his prize essay on the agriculture of the county of Nottingham, when on the treatment of cattle in that district he remarked (*Jour. R. A. S.*, vol. vi., p. 20)—"As there is but very little permanent grass land in this district, the number of beasts kept is greater during the winter than the summer months. Many of the farmers sell off almost all they winter in the spring months to the summer grazier, and buy in again to supply themselves in the following autumn. When the turnip crop is an abundant one, the number of fat cattle sent to market throughout the winter is very great. When that crop is less abundant, much fewer are made fat, the farmer's attention being directed chiefly to the converting of his straw into good manure, without drawing many turnips to be consumed in the yards. Any profit that he might realize on the feeding of cattle he well knows would be more than counterbalanced by a diminished crop of barley, where such turnips ought to have been eaten on the ground. He accordingly contents himself with preparing beasts for the summer grazier by sending such stock to market in good condition, rather than by fattening them himself to the injury of his farm. This he does by giving to each beast a moderate allowance of linseed-cake, varying from 4 to 6lbs., according to their size, other circumstances also being considered. The animal is thereby kept healthy, and with only a daily allowance of 4lbs., which is the minimum of what ought to be given, will at least maintain its condition. Each beast will thus cost during the six winter

months from £3 to £4, more or less, according to the price of cake at the time. When, however, the farmer has in prospect his next year's turnip crop, and looks still beyond to the barley crop which is to succeed, a proportion of his beasts will most probably be allowed 8lbs., and such as are being made fat from 12 to 16lbs. each, which will impart a power and goodness to his manure, visible, wherever it is applied, for years afterwards. The best farmers have long since ceased to give cake to their stock, at those times only when they find a profit on that stock to justify them in doing so. They now look upon the conversion of their straw into the best possible manure as an object of the highest importance to their farms. They calculate how they shall use the greatest amount of cake—which they regard as an indispensable in good farming—at the least possible loss; for, as prices both of beef and mutton have of late been, they must necessarily incur a loss if they expect their remuneration from the live stock instead of from the land. The farmers take a wide view in this matter, and, we think, regard their interests in their true light. Mr. Pusey has observed, in his spirited description of Lincolnshire farming, that there the cattle are looked upon only as 'machines whereby to make manure;' and upon the same principle does the Notts farmer act when he considers his straw, which increases year by year with the improved condition of his farm, as a 'vast number of tubes,' whose use is to be filled with liquid manure, and carried out to the support of his future crops."

Thus is well described one great agricultural use of oilcake. Its relative value as food to stock, however, is great. A few important chemical examinations on the subject will be usefully studied by the farmer. Professor J. F. Johnston has given (*Elem. of Chem.*, 275), the following table of the nourishment contained in various substances. Assuming that 10lbs. of hay yield a certain amount of nourishment, then of the other vegetable substances it will be necessary to give the following quantities in order to produce the same general effect in feeding—

	lbs.		lbs.
Hay.....	10	Oat straw	55
Oilcake	2	Turnips	60
Indian corn.....	6	Carrots	35
Oats.....	5	Cabbages	30 to 40
Barley.....	6	Potatoes	28
Peas and beans	2 to 3	Clover hay	8

The composition of linseed cake and of swedish turnips is thus given (*Johnson and Shaw's Farmers' Almanac*, vol. iii., p. 45)—

	Turnip.	Oilcake.
Water	80.02	10.05
Oil	0.25	11.93
Sugar	5.37	—
Mucilage	—	—
Acid of turnip and albumen	4.24	39.10
Albumen and gluten	—	22.14
Woody fibre	1.22	9.53
Saline matter and ash ..	0.68	7.25

The high proportion of nutritive matter in linseed cake is accounted for by this analysis. It would seem to us that to a still more economical extent the linseed meal itself (mixed with other substances, such as turnips or hay, to counteract its purgative qualities) might be employed; for this contains a still larger proportion of the nutritious oil, which even by itself has been found so nourishing. By this means, too, the adulteration and residue of inferior seeds sometimes employed by the seed crusher are avoided. In the manufacture of oilcake, Mr. James M'Adam remarks, in his prize essay (*Jour. R. A. S.*, vol. viii., p. 392)—"The seed is crushed between metal rollers, then ground under edge millstones, heated in a metal vessel, in which it is kept constantly stirred by machinery, and the oil then extracted by pressure. The residue is the cake. When made of the seeds of hot countries, India, Sicily, Egypt, or Turkey, it is tolerably pure; but the greatest proportion made in England is from Russian seed, which is generally inferior, and very much mixed with the seeds of weeds containing a much smaller proportion of nutritious substances. The amount of oleaginous matters contained in flax-seed varies very much, and in the produce of warm climates is always the largest. Thus the yield of oil from a bushel of East Indian seed is 14¾lbs. to 16lbs., of Egyptian 15lbs., of Sicilian 14½lbs. to 15½lbs., of Russian 11lbs. to 13lbs., of English or Irish 10¾lbs. to 12lbs. It is evident," continues Mr. M'Adam, "that the expression of the oil renders the cake less valuable for feeding, as oleaginous matters contain a larger proportion of nutriment." The oil has been actually used with considerable success for fattening cattle, given with hay or turnips. There is no doubt, however, that the seed is more wholesome; but by itself it should be cautiously given, as it is apt to act as a purgative. This is obviated, however, by an admixture of straw or other coarse substances. In this section I have regarded chiefly the nutritive power of malted barley and of linseed cake, the first only *promising* well as an article of food, the other of long-established value, and in many districts enlarging consumption. There are other substances to which we have on former occasions alluded, and some to which we

shall ere long recur. I shall ever earnestly labour on this great branch of a farmer's practice, from a conviction not only of the importance of already accomplished modern scientific researches, but from the full persuasion that much more considerable and practical results, too, are yet to be obtained for the grazier's profit.

STALL-FEEDING.—PREPARED FOOD.

When in a previous section of this work (*see ante, p.* 29) I addressed myself chiefly to the relative value of green food, and when the food was dried or made into hay. It is apparent, from the experiments we then examined, that when grass is carefully dried without the ordinary losses sustained in haymaking, from the rains and by fermentation, that its nutritive power is fully equal to that of the green grass from which it is made. Some experiments, too, of M. Boussingault even led to the conclusion that the dried fodder excels in nutritive power the same food before its water by a gentle heat is removed from it. This, we may remember, accords with the practice of many feeders of stock, and also with an opinion very common amongst the cottagers of Essex, that in the fattening of their pigs they consider that it is the most economical plan to give their food, whether grain or meal, in a perfectly dry state. Admitting, then, that there are useful and profitable results to be obtained from these examinations, there next arises, by way of increasing our knowledge in the same direction, the further question to determine by experiment—does the addition of moisture to this dried food before it is given to the animal vary in any material degree its nutritive powers? The question has also been considered by M. Boussingault, who tells us (*Quar. Jour. Agric.*, 1847, *p.* 138) —"Some breeders are in the habit of steeping the dry forage for cattle, in the belief that hay and clover acquire, by being thus soaked, more powerful nutritive properties. The amount of water absorbed in that operation is such, that 25lbs. of dry clover will, after twenty-four hours' infusion, weigh 100lbs. It seems, then, that by being steeped dry, fodder returns in some manner to its former green condition. It might be presumed that during the late hot and dry summer moist food would be more profitable to the cattle than the hay given them, in consequence of the scarcity of herbage, the second crop of clover having pretty generally failed. Upon that consideration I determined on making a comparative trial, in order to ascertain the effect of steeped fodder. The details of the following experiment I committed to M. E. Opermann. Four heifers, from seventeen to nineteen months old, were divided into two lots. Lot No. 1 consumed hay and dried clover. Lot 2 received the same quantity and the same kind of fodder, previously steeped during twelve hours. Each lot was daily fed in the proportion of 3lbs. of hay for each 100lbs. of living weight. Lot 1 (on

steeped fodder) weighed 1,594lbs. 7oz.; lot 2 (on dried fodder) 1,704lbs. 13oz. After fourteen days it was found that they had gained in weight—

	Total gain.	Daily gain.	Food consumed.
Lot 1 ..	50lbs. 13oz.	3lbs. 3⅞oz.	668lbs. 8⅞oz.
Lot 2 ..	44lbs. 2⅜oz.	3lbs. 2½oz.	689lbs."

This experiment was then repeated for another fourteen days, with the alteration that the steeped food was now consumed by the cattle that had hitherto received dry fodder. The result obtained did not differ much from the previous experiment.

Lot No. 1, on dry food, gained 50lbs. 13oz.
Lot No. 2, steeped food ..... 48lbs. 9oz.

So that, upon the whole, the conclusion to which M. Boussingault arrives seems pretty near the truth when he observes—"The difference that seems to result in favour of the steeped hay is so slight, that it may very easily arise from an error in the observation; but this difference, were it real, would not pay for the trouble and annoyance attending the operation of steeping." It was determined, however, that the steeped fodder was consumed by cattle with more rapidity. "In a word," he adds, "dry food, after having absorbed two or three times its weight of water, must present the advantages that occur in green forage, which, if not more nourishing than the hay produced from it, is at least consumed with greater avidity. Hence it results that green feeding is generally more profitable, and this would probably be also the case with steeped fodder if given in the same quantity and under the same conditions." The effect of the steeped hay upon the production of milk seems imperceptible, according to the observations of the French farmer. "Two cows," he remarks, "were daily given 3lbs. of dry forage for every 100lbs. of living weight. To the one steeped food was given, to the other ordinary hay. After a fortnight of the two dates, no difference whatever was to be perceived in the production of milk." If, then, it is once pretty well established that dried food, or food merely deprived of its water, is more nutritious than in its green state, this appears to be another step in advance towards the consideration of another most important question in stock-feeding, viz., the advantage of giving live stock prepared food—that is, a boiled or steamed diet. The observations and trials of Mr. Joseph Marshall, of Holme Lodge, near Bedale, are on this great question worthy of our careful and repeated consideration; he very truly tells us in his valuable prize essay, yet with a modesty that prejudices us at once in his favour (*Journ. R. A. S.*, vol. vii. p. 391)—"The principles here laid down have been long, though perhaps not generally, known. All the merit which the author claims is that of having persevered, in spite of friendly remonstrances,

ridicule, commiseration, and the like, in a course which his own reflection and calculations recommended, and which his own experience and the larger experience of more able and scientific farmers have since proved to be successful." That cattle and other stock may with ordinary care be fed upon food artificially prepared in the method (steaming) which he describes, that the saving in consumption will more than repay the attendant labour and expense, that an opportunity is thus given for consuming corn of inferior quality with advantage, and that the cattle thrive upon it, are facts which he considers beyond doubt. And he continues—"The best artificially-prepared food which we have hitherto found is boiled linseed, ground corn, and cut straw, along with some raw turnips given at intervals. A heifer weighing from forty to fifty stone, will consume daily two pounds of crushed linseed boiled in three-and-a-half gallons of water for two or three hours, five pounds of ground corn, ten pounds of chopped straw, and about eighty or ninety pounds of yellow bullock turnips, with a little straw not cut, placed in their racks at night." The cost of food thus prepared, from the following statement—in which no charge is made for straw and turnips, and in which ample allowance is made for coal, labour, and outlay of capital—appears to be 4s. 4d. for each head per week.

This statement gives the cost of prepared food for twenty-two head of cattle and three draught horses for eight weeks, in 1844 and 1845; the linseed (which weighed 54lbs. per bushel) being omitted on Sundays:—

	£	s.	d.
46½ bushels of linseed, at 6s.	13	18	0
458 stones of ground oats, at 11½d.	21	18	11
Wages, eight weeks, at 13s.	5	4	0
1 cwt. of coals per day, at 15s. per ton	1	1	0
Interest on outlay of £50, wear and tear eight weeks	1	5	9
	£43	6	8

The cattle were fed according to the following mode:—At six o'clock A.M. each beast was supplied with about 40 to 45lbs. of yellow bullock turnips, sliced; at ten A.M. with 1lb. of linseed, boiled for two or three hours, with about 1¼ gallon of water, 2¼lbs. of ground corn, and 5lbs. of chopped straw; at one P.M. the turnips were repeated, and at five o'clock P.M. the prepared food was repeated; at night a little straw was placed in the racks. If any cattle had refused their mess, it was removed and given to those that had finished theirs and were desirous of more. It may also be observed that the ground corn and chopped straw must be mixed together first, and then the boiled linseed, being poured upon them and mixed with them, may be allowed to stand for one or two hours and given while yet warm,

for if allowed to stand a few hours the mass ferments and quickly turns sour. Hence the necessity of the strictest cleanliness in all the vessels and implements made use of; regularity and cleanliness, highly important as they are in every system in feeding animals, are in this method the basis of success: without them every attempt must inevitably fail. I have found that the omission of this food once on a Sunday makes the animals return to it with an increased appetite. Under this mode of feeding three year-old heifers increased in weight (calculating by measurement), during the time they were tied up, on an average of the whole lot, about 14lbs. each per week. Two of them made 20 stone each, in sixteen weeks. Steers consumed less food, and gained weight more slowly. The draught horses had their allowance of prepared food on coming from work; when at constant work, and in long days, each horse was supplied with about 5lbs. of ground oats or split beans, in addition to the 5lbs. contained in the prepared food. During the three winter and other months in the year that my horses have had this provender, they have improved in their condition, have been free from disease, and capable of performing any work that horses kept for agricultural purposes could reasonably be required to do." The method thus advocated by Mr. Marshall he has carried out, it seems, on a small farm, since 1843, with every success. Of course, the improvement in the quality of the manure thus produced has been very considerable. He says—"The effects of this system have been so apparent in the increased fertility of the farm where it has been practised as to induce my neighbours to follow my example." He gives the valuable evidence of two or three practical farmers in corroboration of his statement; for instance, Mr. H. S. Thomson, of Moat Hall, near York, who fed two bullocks, Nos. 8 and 9, for a month, according to his old plan, viz., with Swede turnips, linseed cake, and bean meal; and two bullocks, Nos. 12 and 13, of the same age and condition, with the prepared food, with the following results:—

No.	Live weight April 11.			Live weight May 15.			Gain.	
	st.	lbs.		st.	lbs.		st.	lbs.
8....	83	8	....	88	4	....	4	10
9....	79	8	....	85	1	....	5	7
12....	81	0	....	85	2	....	4	2
13....	85	0	....	89	0	....	4	0

"As I was convinced," he adds, "that the two bullocks which had made the least progress were nevertheless the most thriving animals, I for the next month fed all four alike, viz., on swedes, mangold-wurtzel, and the prepared food. The results are as follows:—

No.	Live weight May 15.			Live weight June 15.			Gain.	
	st.	lbs.		st.	lbs.		st.	lbs.
8....	88	4	....	92	4	....	4	6
9....	85	1	....	90	12	....	5	11
12....	85	2	....	92	7	....	7	5
13....	89	0	....	96	0	....	7	0

The impression, therefore, that the bullocks Nos. 12 and 13 were better thrivers than Nos. 8 and 9 was fully borne out when the four were fed alike. Upon the whole, then, after having given this question the most careful and anxious attention, we incline strongly to the conclusion that the preparation of the food of live stock is a question well worthy of the most anxious, yet of course cautious, examination of the English farmer. In this view, too, we are supported by the opinion of a very eminent flock-owner, Mr. T. E. Pawlett, of Beeston, who tells us, in a valuable essay (which we regret did not also get a prize awarded to it by the R. A. S.)—"Before I conclude, I must again remark (*Farmer's Mag.*, vol. xxvi. p. 219): Urge the use of clover hay cut into chaff for all kinds and conditions of stock, as I believe its worth is not yet sufficiently known. On the other hand, I cannot help again stating that, in my opinion, the value put upon corn or pulse and oilcake for feeding sheep and cattle has been greatly overstated. I think the time is not far distant when they will give place (in the state they are now used), in a great measure, to nearly equally feeding, but more economical food, as clover hay, prepared linseed, and other compounds."

STALL FEEDING.—VARYING QUALITY OF FOOD.

The comparative value of the food of live stock is one of greater difficulty, and must be examined with much more patient caution, even in comparative trials, than is commonly believed. There are many influencing causes, such as the kind and state of the stock and the price and quality of the food, which must ever materially influence, and sometimes reverse, our most apparently safe conclusions. Even when a lot of animals are set aside and divided into two portions, for the sake of a fair trial, yet then, so great is the difference between the fattening properties of some animals, and others even of the same family or litter, that it is only by continued trials that any tolerably certain conclusions can be attained. Whoever, in fact, commences such trials must resolve to find not only patient perseverance, but the determination to labour after truth with that zeal and watchfulness without which no valuable agricultural information can be gained. At the conclusion of an able prize essay on the management of cattle, Mr. W. H. Keary, of Holkham, not long since alluded to some of these things when he reminded the English farmers (*Jour. R. A. S.*, vol. ix. p. 451),

when speaking of the food of cattle, that not any single experiment, or even a series of them, are, or ought to be, at all conclusive when we examine practically the difficulty of the question they are required to decide. To give an instance, suppose that six oxen are taken to test the effects of two different modes of fattening, three being intended to be treated on one system, and three upon the other. How difficult it is, we all know, to select six animals from any drove, however large, possessing in the same degree equal and similar qualifications; and hence the difficulty—nay, almost impossibilty—of deciding fairly by any experimental results. Two out of the six oxen may be diseased and unable to digest properly, and cannot consequently assimilate their food. A close and careful observation in our daily practice of the different effects of food and treatment is more likely to lead to correct results than a too great reliance upon experiments which manifestly must always be conducted under a considerable degree of doubt and uncertainty. "It would be absurd and unprofitable," adds this intelligent Norfolk farmer, "to attempt to lay down any precise rule as to what sort of artificial food should be used; they who attempt to decide generally on this matter are, perhaps, too apt to forget one important point, namely, the relative prices of these different descriptions of food. When linseed-cake is at a high price and grain at a low one, it will naturally occur to the consumer to use the cheaper commodity; and thus in certain seasons, and under peculiar circumstances, that system which might be a profitable and a proper one to adopt would, under a different state of things, prove wholly inapplicable." But, after making all these allowances, and guarding ourselves against the errors of speculative theorising, there yet remains to reward our inquiries many well tested truths—a yet promising field of unexhausted discoveries to reward the patient and laborious stock-feeder.

The practical Norfolk mode adopted by Mr. Keary he thus briefly describes:—"A moderate quantity of roots (turnips in winter and mangold wurtzel in the warmer weather of spring), combined with a limited portion of artificial food, will prove more fattening than an unlimited supply of both. From two-and-half to three bushels of swedes, and two bushels of mangold wurtzel, with from seven to ten pounds of linseed-cake or meal per day of various sorts, mixed up in cut hay, I usually find sufficient for the generality of bullocks. If a little long hay can be spared, it is a valuable addition, as encouraging the proper process of rumination, and thereby promoting and preserving health." If to this valuable truth, acquired by long experience in the stock-yard, we add cleanliness, quiet, regularity, and warmth, we shall perhaps have included some of the most unerring truths on which the feeder can safely rely. It is always, however, useful if we can reduce any scientific or practical trials to a comparative statement, even though the results should

prove sometimes discordant. It is well known, for instance, that the blood-forcing or nutritive portion of food is totally different from the calorifent or heat-producing portion; that they exist in different proportions not only in various substances, but even in different specimens of the same kind of food.

These comparative proportions may be given as in the following table, which shows, according to the trials of Dr. Thomson (*Food of Animals*, p. 167), the relation of nutritive matter to calorifent matter in—(*For grains see post p.* 110).

Cows' milk as	1 to 2	Potatoes	1 to 9
Human milk	1 — 2½	Rice	1 — 10
Oatmeal	1 — 5	Turnips	1 — 11
Beans	1 — 6	Arrowroot, Tapioca, Sago	1 — 26
Samolina, Barley	1 — 7		
Wheat flour	1 — 8	Starch	1 — 40

Mr. E. Lawes (*Jour. R. A. S.*, vol. x., p. 336) has made a short digest of the result of the trial in stall-feeding made by several farmers, in which he contrasts the consumption of food and the increase of cattle for each 100lbs. of live weight, as recorded by various observers. In the subjoined table, column 1 gives the number of the oxen; 2, the length of the trial in weeks; 3, the quantity of food in pounds and ounces consumed weekly to each 100lb. live weight of the animal; 4, the increase per week upon each 100lb. of live weight, given in pounds and ounces. The first two lots were fed by Mr. H. S. Thomson, the two next by Mr. Postle, the last two by Mr. J. H. Leigh:—

1.	2.	3.			4.	
4	5	Linseed	0	13½	1	8
		Bean-meal	2	12½		
		Straw and turnips				
4	4	Oilcake	1	13	1	1⅓
		Bean-meal	1	13		
		Turnips				
6	22	Peas	1	13	0	14
		Linseed	0	8		
		Turnips	64	0		
6	22	Oilcake	3	5	0	13½
		Turnips	66	0		
27	9	—			1	4¾
30	10	—			2	12

That the ordinary cultivated roots of the farmer vary in their chemical composition is a fact that has only very gradually been established. It is true that this variation in the composition, and consequent feeding-value of plants in extreme cases, such

as in very young or very old specimens of any root, must have been long apparent to every owner of live stock; but that plants of the same kind, age, and vigorous growth should materially differ in their nutritive powers according to the variety, the soil, and the manure employed in their production, is a truth that, although long unsuspected, has been tardily admitted by the English stock-owners. The first suspicion, perhaps, of this kind arose nearly half a century since, soon after the introduction of crushed bones as a drill-manure for turnips. The great Lincolnshire farmers, who were the first to generally employ this manure, soon began to find out that the bone-manured turnips exceeded, in their nutritive qualities, the same roots produced in the same field when dressed with other manures. "It may be correctly added," said Mr. Brailsford, of Barkwith (*Johnson on the Fertilizers*, p. 148), "that in this county it is considered that the feeding quality of turnips raised from bones exceeds that of the roots produced from dung." That the use of this manure should thus influence the nutritive powers of the turnips might be ascribed by these great cultivators to the increased amount of the phosphate of lime which the bone-dressed turnips would be reasonably expected to contain; and, in fact, in the case of turnips grown with guano (another manure largely composed of the phosphate of lime) the increased presence of this salt has been shown by a careful chemical examination in this valuable field of research, as is remarked by the editors of *Johnson and Shaw's Farmers' Almanac* (vol. ii., p. 243). Some highly important results have been obtained by Professor Johnston, at the instance of the Agricultural Chemistry Association of Scotland, with regard to the influence which different manures appear to exert upon the composition of the Swede turnip (*Trans. High. Soc.*, 1845, p. 470). Two specimens were examined: 1, grown with farm-yard dung only; 2, with guano only. The bulbs were analyzed when green, and also when evaporated to dryness. 100 parts of the organic portion of these contained—

	Undried from		Dried from	
	Dung.	Guano.	Dung.	Guano.
Water	80.02	87.93		
Oil	0.25	0.16	2.09	1.26
Gum	0.27	0.19	2.27	1.57
Sugar	5.37	1.64	45.82	13.59
Pectic acid and albumen	1.24	0.71	10.35	5.88
Metapectic acid	3.00	6.77	25.04	56.09
Cellular or woody fibre	1.22	1.81	10.18	15.00
Saline matter and ash..	0.68	0.70	5.68	5.80

The ashes of these turnips differed still more remarkably in

their composition. We earnestly commend the results of these important researches to the study of the farmer.

	Dunged.	Guanoed.
Chloride of potassium ...	9.72	6.45
Potash and soda.....	45.49	36.29
Magnesia.....	1.23	0.39
Lime.....	10.17	11.56
Sulphuric acid	17.86	16.86
Phosphoric acid	7.73	19.39

It seems certain that manures affect the composition of plants, M. Vogel also proved this in the case of two plants grown in the same soil, of the Fuchsia fulgens, 100 parts of which contained—

	Soil (simple).	Guanoed.
Water	86.5	81.0
Ashes	7.5	6.2
In the ashes were contained—		
Carbonate of lime	40.2	25.4
Carbonate of magnesia..	23.7	27.1

On the relative feeding properties of these dunged and guanoed turnips an admirably conducted experiment was made by Mr. W. Goodlet, at Lennox Love (*Trans. High. Soc.*, 1845, p. 476), who noticed, amongst other things, that the guanoed turnips kept better when stored in pits than the dunged. The cattle were three-year-old Angus on January 22, 1845; after a month's grass they were put into a feeding court on full turnips and 3½lbs. of oil-cake each beast per day. On the 22nd of Jan. they were placed in two courts, in two equal lots; for six weeks they were fed with turnips grown with half dung and half guano, and then 3½lbs. of oil-cake. At the end of that period they were fed—lot 1, with the guanoed; lot 2, with the dunged turnips—still with the 3½lbs. of oil-cake, and on the 18th of March 3½lbs. of bean-meal, "in seeds," was given, and continued during the experiment. The following was their live weight, in pounds, during the experiment:—

Weight Jan. 22.		Weight March 6.		Weight Apr. 19.	
Lot 1. Guanoed Turnips.	Lot 2. Dunged Turnips.	Lot 1. Guanoed Turnips.	Lot 2. Dunged Turnips.	Lot 1. Guanoed Turnips.	Lot 2. Dunged. Turnips.
1206	1375	1288	1493	1296	1546
1306	1190	1395	1271	1400	1283
1043	1214	1079	1252	1182	1298
1157	1102	1249	1171	1328	1313
1272	1115	1312	1143	1342	1212
5984	5996	6323	6310	6548	6652

The turnips used in these valuable experiments were from the same seed, sown on the same day and field; the final results of which will be seen in the following table, where is inserted a column showing the value of the crops according to their feeding qualities (calculating the increased live weight at 3d. per lb.) as ascertained by the above experiments :—

Manure.	Produce.	Value.
	Tons.	£ s. d.
Guano, 6½ cwt.	17,500	4 15 0
Dung, 24 loads	17,142	7 16 5
Rape dust, 16 cwts.	16,830	0 0 0
Guano, 3¼ cwts Dung, 12 loads	14,907	5 18 4

If, then, the chemical composition of the manure influences materially that of the turnips to which it is applied, then another important question presents itself—does the composition of the soil exert an equal or a material influence in the same way? And are different varieties of the same root composed exactly of the same chemical ingredients, and in the same proportions? These very valuable inquiries have also engaged the attention of Professor J. F. Johnston (*Farmers' Almanack*, vol. iii., p. 231). He found, per cent., in different varieties of the turnip (1 and 2 from Drummore, 3 and 4 from Haddington)—

	On the same Soil.		On the same Soil.	
	1 Purple.	2 Yellow.	3 Purple.	4 Yellow.
Water	88.46	88.60	87.45	88.31
Sugar	6.90	6.92	8.39	7.67
Gum	0.09	0.09		
Albumen	0.19	0.22	0.32	0.21
Pectic, &c., acids	—	—		
Oil	0.26	0.30	3.84	2.81
Cellular fibre	3.39	3.00		
Saline matter	0.68	0.62		

Three varieties of mangold wurtzel yielded per cent. :—

	Long Red.	Short Red.	Orange Globe.
Water	85.18	84.68	86.52
Gum	0.67	0.50	0.13
Sugar	9.79	11.96	10.24
Casein	0.39	0.26	0.33
Albumen	0.09	0.18	0.03
Fibre, pectic acid, &c.	3.38	3.31	2.45

THE LAND REQUIRED FOR A COW.

The question which naturally suggests itself to every young cowkeeper, is the quantity of food which the cow will require, and the extent of land needed to produce that amount of food. This is a question not capable, it is true, of a very accurate answer; but still, an approximate calculation may be made, and certain results of trials given, which it will not be difficult for the reader to apply to the circumstances in which he is placed. Let us then see, first, the quantity of food daily consumed by a cow; secondly, the arable land which she needs for her support; and, thirdly, the grass-land required to furnish her with green-food in summer and hay in winter.

Now, we have seen, at p. 8, that in the isle of Jersey a cow is fed daily (under cover, from October to February) with a certain portion of straw, from 10 lbs. to 20 lbs. of hay, with about 10 lbs. to 20 lbs. of parsnips, white carrots, turnips, or mangold-wurzel.

In some useful trials with a young cow, ten months old only, by M. Boussingault, she consumed during ten days, on an average, about 50 lbs. of cut green clover per day, and during the next ten days, on an average, of the same cut clover made into hay about 16¼ lbs. per day—see p. 31. Then, again, we have seen (p. 49.) that the widely differing nutritive qualities of various articles of food require a different allowance in weight of these to the cow. Thus, for every 10 lbs. of meadow hay consumed by the cow, we must substitute 55 lbs. of oat-straw, 60 lbs. of sliced turnips, 35 lbs. of carrots, and 30 lbs. to 40 lbs. of cattle-cabbages. In any way, the cowkeeper must bear in mind that the cow must be liberally fed with as much food as she will eat—by no stinting mode of feeding can a profitable return be expected.

We next inquire as to the quantity of arable land whose produce would be required to support a stall or yard-fed cow. This was a question which engaged the serious attention of the late Mr. Davis Gilbert, who had several tenants that kept cows in this way, all on land cultivated by the spade or fork, on the chalky soils of the Sussex South Downs; one of whom thus described his mode of cultivation, in answer to a Yorkshire inquirer—(*Johnson and Shaw's Farmers' Almanac*, vol. i, p. 138.)

"You have seen the account of my management of a small quantity of land, three acres, on which I feed two cows by spade husbandry; I must say that the statement you saw was very true. Half an acre of pasture, half an acre and eight rods in wheat, and one quarter of an acre in oats, the other part was green food for the cows, such as rye, tares, cabbage, clover, mangel wurzel, turnips, Italian rye grass; but if you are surprised at my keeping them on this quantity of land, I must tell you that one crop in a year will not do it; but my plan is to take

a successive crop, that is, rye is the first thing that I cut green in the spring, then I dig the land up and manure it with the liquid manure as far as it will go, then finish with rotten dung, and plant mangel wurzel and turnips, and the part that I manure with *liquid* is always the *best;* the next thing I cut is winter barley and tares, which I get off soon enough to sow more turnips and plant some cabbage for winter; by this time I cut the Italian rye grass and clover, which grows again in a short time with a little of the liquid manure as soon as it is cut. Last summer I cut the Italian rye grass and clover three times, and this year I have nearly cut it twice already, and there really were two good crops of the Italian rye grass, and I think there will be two more this summer with a little manuring. My early cabbage I always let stand to grow again all the summer, and they bring a great deal of food—then I plant in November, and put the liquid manure to them, when I plant as far as it will go, but to the rest I use dung or ashes, which are not so good as the liquid, which anybody may tell in the spring by looking at the bed of cabbage. So now, Sir, I hope you understand what I keep the cows on in winter as well as summer. I had no hay last winter, only turnips, mangel wurzel, and straw, and my cows did very well all the winter."

But what quantity of artificial roots, per rod, it may be asked, is common land likely to produce when thus carefully tilled and fertilized? (A rod is the 160th part of an acre, and contains 30¼ square yards.) Now this very question will be found answered in the following prize list of the Spade Husbandry Association of Farnley Tyas, near Huddersfield, of November, 1849, a district neither remarkable for the goodness of the soil or its climate:—

Farm Premiums for Farnley and other Townships.

By the Plough.

Mr. Jonathan Senior, for wheat, 34 lbs. in ear, 66 lbs. straw per rod.
Mr. John Kaye, for oats, 114 lbs. corn and straw, per rod.
Mr. Jonathan Senior, tares, 13½ tons per acre.
Mr. John Kaye, turnips (Swedes), 28¾ tons per acre.
Mr. Jonas Kenyon, mangel wurzel, 19 tons per acre.
Mr. Joseph Scott, Belgian carrots, 14½ tons per acre.
Mr. Joseph Scott, turnips after a green crop, 19¾ tons per acre.

By the Spade.

Mr. George Sykes, for wheat, 34½ lbs. in the ear, 61 lbs. straw per rod.
Mr. Jonathan Senior, potatoes, 15½ tons per acre.
Mr. Jonathan Senior, turnips, 27½ tons per acre.
Mr. James Sykes, mangel wurzel, 20¼ tons of bulbs, tops 14 tons per acre.

On Cottage Allotments by Spade Husbandry.

Mr. Mark Mellor, for wheat, 38 lbs. 7 oz. in the ear, 119½ lbs. straw per rod.

Mr. Mark Mellor, for turnips, 26¾ tons per acre.

Mr. John Booth, turnips after potatoes this year, 25½ tons per acre.

Mr. Mark Mellor, for mangel wurzel, 26½ tons per acre.

Mr. Mark Mellor, for potatoes, 24½ tons per acre.

Mr. William Brooke, for carrots, 12¾ tons per acre.

Mr. Mark Mellor, for white beet, 16¾ tons per acre.

The expense of digging, or, what is much better, forking the land after a white crop, is about 2d. to 2½d. per rod; and at this rate, the ordinary earnings of a labourer, according to the extensive experience of Mr. Mitchell, of Wymondham, in Norfolk, is about 11s. to 12s. per week, or about £1 13s. 4d. per acre.

The expense, then, may be calculated by placing the rent, public burthens, two diggings, and cost of seed per annum of, say 1½ acres of land, on one side, and the ordinary average produce of a cow on the other; namely—

A calf,
The milk.

An ordinary cow will yield about 8 to 12 quarts of milk per day; or, if this is made into butter, say 160 to 180 lbs. of good butter annually; or, if made into whole milk cheese, about 300 to 400 lbs.

If the food of the cow is to be grass and hay only, then the produce of grass will vary so very much, according to the soil and other circumstances, that no very useful calculation can be given as to the amount of pasturage needed for a cow. Three or four acres of ordinary grass-land will not be too much to furnish her with grass and hay for the year. In situations where portions of the land can be readily and copiously irrigated, by either river-water or water mixed with house-sewage, the produce is thereby so very largely increased that the grass produced by a small extent of land is amply sufficient for a cow. In this case, the best plan is to divide, by little raised borders, the grass-land into small plots of two or three rods each, and then irrigate the *land as soon as the grass is cut*. By this means the land will produce four or five heavy crops of grass every year; and by dividing the land into these little plots, with raised borders, the sufficiently copious supply of sewage or water is thus readily secured. One quarter of an acre, thus carefully watered with the diluted sewage of a house, will produce as much food for a cow or more than an acre of tolerably good pasture left to nature's care.

THE DISEASES OF COWS AND THEIR REMEDIES.

I can on this question, so important to all cowkeepers, add little to what will be found in *Johnson and Shaw's Farmers' Almanac*: this contains the long-tested results of the practical knowledge of the stockowner and the veterinarian:—

Cows.

Calving.—The treatment before calving is to keep the cow moderately well, neither too fat nor too lean; remember that she commonly has the double duty of giving milk and nourishing the fœtus: dry her some weeks before calving; let her bowels be kept moderately open; put her in a warm sheltered place, or house her; rather reduce her food; do not disturb her when in labour, but be ready to assist her in case of need; let her have warm gruel; avoid cold drinks. A pint of sound good ale in a little gruel is an excellent cordial drink.

Cleansing Drink.—1 oz. of bayberry powdered, 1 oz. of brimstone powdered, 1 oz. of cummin-seed powdered, 1 oz. of diapente. Boil these together for ten minutes; give when cold in a little gruel.

Colic.—The best remedy is 1 pint of linseed oil mixed with ½ oz. of laudanum.

A Cordial is easily made by 1 oz. of carraway seeds, 1 oz. of aniseeds, ½ oz. of ginger powdered, 2 oz. of fenugreek seeds. Boil these in a pint and a half of beer for ten minutes, and administer when cold.

Fever.—Bleed; and then give 1 oz. of powdered nitre and two oz. of sulphur in a little gruel. If the bowels are constipated, give ½ lb. of Epsom salts in three pints of water daily, in need.

Hoose.—See *Calves, Diseases of*—only double the doses.

Hoove or Hoven.—Use the elastic tube; but as a prevention, let them be well supplied with common salt, and restrained from rapid feeding, when first feeding upon rank grass or clover.

Mange.—½ lb. of black brimstone, ½ pint of turpentine, 1 pint of train oil. Mix them together, and rub the mixture well in over the affected parts.

Milk Fever, or Garget.—2 oz. of brimstone, 1 oz. of diapente, 1 oz. of cummin-seed powdered, 1 oz. of powdered nitre. Give this daily in a little gruel, and well rub the udder with a little goose-grease.

Murrain.—½ lb. of salts, 2 oz. of bruised coriander seeds, 1 oz. of gentian powder. Give these in a little water.

Pleuro Pneumonia.—The only chances in this disease are the adoption of very *prompt* measures:—Bleed *early*, and repeat it if necessary. Then give a drench, composed of 1 lb. Epsom salts, 1 oz. powdered saltpetre, ½ a drachm of tartar emetic. Give it in two pints of gruel, and repeat in six or eight hours.

Poisons swallowed by oxen are commonly the yew, the water dropwort, and the common and the water hemlock. 1½ pints of linseed oil is the best remedy.

Purge, in Poisoning.—Either 1 lb. of salts in a quart of water or gruel, or 1 pint to 1½ pints of linseed oil.

Redwater.—Bleeding, says Youatt, first, and then a dose of 1 lb. of Epsom salts, and ½ lb. doses repeated every eight hours until the bowels are acted upon. In Hampshire they give four ounces of bole *ammoniac*, and two ounces of spirits of turpentine in a pint of gruel.

Scouring.—Give ½ oz. of powdered catechu, and 10 grs. of powdered opium in a little gruel.

Sprains.—Embrocation: 8 oz. of sweet oil, 4 oz. of spirits of hartshorn, ½ oz. of oil of thyme.

Sting of the Adder or Slow-worm.—Apply immediately to the part strong spirits of hartshorn: for sting of bees apply chalk or whitening mixed with vinegar.

Worms.—Bots: give ½ lb. of Epsom salts with 2 oz. of coriander seed bruised in a quart of water.

Wounds.—*Flesh* tincture. Socotorine or Barbadoes aloes in powder 4 oz., myrrh coarsely powdered 1 oz., rec. spirit of wine 1 pint, water 2 pints. Let them stand 14 days, occasionally shaking; then fit for use. Wounds are best without sewing. Cleanse from dirt and gravel. If much inflamed, apply a poultice. If unhealthy fungous granulation arises, wash the part with the following mild caustic wash previous to applying the tincture:—Blue vitriol (sulphate of copper) 1 oz., water 1 pint, dissolve.

Yellows.—2 oz. of diapente, 2 oz. of cummin-seed powdered, 2 oz. of fenugreek powdered. Boil these for ten minutes in a quart of water, and give daily in a little gruel.

Calves.

Navel Ill.—The best treatment for this dangerous disease is, first, to administer two or three doses (about a wine-glass full) of castor oil (linseed oil does just as well, and is much cheaper); and, secondly, cordials, which can be made of 2 drachms of carraway seeds, 2 ditto of coriander seeds, 2 ditto powdered gentian; bruise the seeds, and simmer them in beer or gruel for a quarter of an hour; give these once or twice a day.

Constipation of the Bowels.—For this doses of castor oil (or linseed oil), of 2 or 3 oz., are the best remedy.

Scouring.—The farmer may *rely* on the following mixture. Let him keep it always by him; it will do for all sucking animals:—

Prepared chalk	4 ounces.
Canella bark, powdered	1 „
Laudanum	1 „
Water	1 pint.

Give two or three table spoonfuls, according to the size of the animal, two or three times a day.

Hoose, or Catarrh.—Good nursing, bleeding, and then a dose of Epsom salts with half an ounce of ginger in it.

MILKING.

In the operation of milking the great rules to observe are regularity, gentleness, and cleanliness. The following observations are taken from an American periodical:—When you go to milk, take a vessel of cold water and sponge. Wash the udder and teats clean, dashing on the cold water. This will prevent the teats from becoming sore, and the udder hot and feverish, besides rendering the process of milking much neater. Milk with clean hands. The whole business of milking is frequently conducted in such a slovenly manner that the milk is entirely unfit for food. The cow should be milked while eating her fodder at morning and evening. She should always be milked and fed at the same time in the day, and uniformly by the same person. Milk without interruption. Be sure to milk the cow as dry as possible. To be milked by different hands, at different times in the day, in a slow, interrupted manner, and leaving part of the milk in the udder, will ruin the best cow in the world.

If the cow has sore teats, foment them before milking with warm water, and after milking, dress them with the following salve:—Melt together one ounce of yellow wax, and three ounces of lard, and as these begin to get cool, rub in a quarter of an ounce of sugar of lead, and a drachm of finely powdered aloes. (*Youatt on Cattle*, p. 552.)

The influence of fear, or anger, or other disturbing causes on the quality of the milk, is not always well understood. As it is remarked by Professor Lyon Playfair, in his valuable lecture on the Application of Physiology to the Rearing and Feeding of Cattle (*Jour. R. A. S.*, vol. iv., p. 215), "anything which tends to annoy or irritate the cow occasions at the same time a partial destruction of the valuable constituents of her milk; hence, it is necessary in dairy farming to use every means to insure the tranquillity of our milch cows. Harsh treatment exerts a very injurious action on the nature of the milk, both from mental and physical causes. Dairymen are well aware of the evil results which follow, if cows be harassed either by dogs or by harsh keepers.

"The great cause which renders milk *poor*, that is, deprives it of its proper quantity of butter, is the respiration of too great an amount of oxygen. This gas combines so easily with butter, that it is of great importance to prevent an excess from entering the body. Now the number of respirations is increased, either by exercise, or by external cooling; hence more oxygen in these cases enters the system, and consumes a proportional quantity of the butter of the milk. We all know when a cow runs, on its

way home to be milked, that the milk becomes hot, and is prone to sourness. The running increases the number of its respirations, and, consequently, the amount of oxygen which enters its system. This oxygen unites with the butter, or, in common language, burns it; and the heat produced in the milk is the result. The milk in such a case is also reduced in volume: this is partly owing to the evaporation of its water by means of the heat thus produced; hence it is that such milk is much poorer than usual, and apt to enter into acidity; hence also the practice of driving home to be milked only those cows which feed near home, while those at a distance from it are milked in the fields. The amount of oxygen inhaled being too considerable, when the animals are driven from a distance, the butter is partly consumed. To obviate an excessive respiration of oxygen, we find that all good dairymen permit their cows to walk home as leisurely as they please, and never allow their driver to accelerate their pace.

"A singular system is frequently pursued, which may be explained on this principle. In hot weather in summer, the cows are fed in the stall during the day, and turned out to grass during the night. Cattle are apt to be annoyed by the flies and by the heat during the day. The former cause them to move about to avoid their attacks, and thus they respire a greater amount of oxygen. This oxygen consumes that part of the food which otherwise would have been transformed into butter; but when let out at night they are not thus disturbed, and the darkness prevents their wandering about: thus they obtain exercise sufficient to furnish them with a good appetite, and the butter in the milk is not consumed. On the other hand, if the night proved cold, more injury than good would be experienced by this system, for a greater amount of butter would be destroyed. Stall-fed cows furnish the greatest proportion of butter. Any deficiency of heat must occasion a combustion of butter to supply the requisite quantity. On this account we select warm sheltered pastures for our cows, and do not expose them to sudden changes of temperature. When butter is the object desired by the dairyman, too rich pasture cannot be supplied to his cows.

"The production of cheese in the milk involves certain other conditions. I have travelled through the principal cheese districts to acquire information on this point, but the evidence furnished by cheese-dairymen is very conflicting, and apparently contradictory. Almost all cheese districts agree in asserting that *poor* land is best adapted for cheese, though there are certain other districts in which the very reverse is affirmed. This arises from the quality of cheese manufactured: those dairies which depend equally upon their butter and cheese, and prepare the latter principally from skimmed milk, must possess rich pastures fitted principally for butter; but in dairies such as those of Somersetshire or Cheshire, in which butter is of a secondary

consideration, their pastures are in reality not so rich. In Gloucestershire and Somersetshire I found the opinion prevalent that poor land produced the *best* (greatest amount of?) cheese; and in the third volume of *Young's Six Months' Tour* it is stated, 'in Cheshire they find that the inferior sorts of pasture lands are the best suited for cheese.'

"In poor lands the cows have more ground to traverse in order to obtain a sufficiency of food, and consequently the oxygen respired by the increased exercise compels them to eat a greater quantity. By this increased quantity more cheese (casein) is furnished to the milk. Land is considered rich, not when its grass abounds in albumen, but when it contains the constituents of food fitted for the production of fat. And, if my opinion be correct, viz., that the waste of the tissues increases indirectly the amount of casein in the milk, then another reason is given why poor land should be better adapted for the growth of cheese than that which is rich.

"Rich grass (*i. e.* grass which contains a large proportion of carbon) is more fitted to sustain the animal heat of the body than grass of a poorer nature—consequently less of it is necessary for this purpose, or, in the language of agriculturists, its *equivalent* is higher. The equivalent of poor grass being lower, a greater quantity of it is consumed by the animal for the support of the heat of its body, and hence the casein (cheese) in the milk is increased. To induce the cows to eat a *large quantity* of food (an indispensable condition, as the casein is in small proportion in grass), we find in large cheese-farms that they are driven to a fresh pasture every day. Very little cheese is produced from the milk of stall-fed cows, on account of the small quantity of food consumed in the stall, and consequent diminution in the amount of casein. But the pastures fitted for the production of cheese should not be, strictly speaking, poor. Stilton, Cheddar, and Cheshire cheeses contain a very large amount of butter; consequently the milk of the animal must contain a considerable quantity of this ingredient. In some parts of Somersetshire the cows are put into rich and poor pastures alternately after each milking.* This ensures the requisite quantity of butter, as well as of casein.

"The different flavours of the cheeses of various districts depend more upon the difference on the chemical state of the rennet with which it is prepared than in the herbage upon which the cows feed; still there is no doubt that particular plants impart a peculiar flavour to the milk. We are well aware that swedes possess this property. Newman, as far back as the commencement of the last century, observed that milk is ren-

* Information furnished by Mr. Norris, near Bridgewater.

dered yellow by taking saffron, bitter by wormwood, and odorous by garlic*.

"The greatest care must therefore be taken in removing from the pasture those plants which may prove injurious to the cows feeding upon them. To give an example of the necessity for precaution, I may cite an instance which fell under my own observation. A few months since Professor Liebeg, Dr. Buckland, Dr. Daubeny, and myself were examining the pastures of a celebrated cheese-farm in Somersetshire. The proprietor of the farm took us to a field, the *grass* of which he affirmed *scoured* the cattle so much that it was unfit for pasture. Being well aware that this was not due to the grass, we began to examine the cause, and Dr. Daubeny found that purging flax (Linum catharticum) grew luxuriantly over the whole field. This plant is quite noted for its purgative action, and at once explained the mystery. The next pasture to which we were taken had quite the opposite character; and the cattle, after feeding on the first, used to resort to the second to correct the purgative effects received by this noxious plant. In this new pasture we found the common tormentil or septfoil (Potentilla tormentilla) abounding; a plant equally well known for its astringent qualities. Attention to the eradication of these two weeds would have at once restored the pastures to their proper condition (*See post* 110).

"In London, Edinburgh, and Glasgow the system of stall-feeding cows is extensively practised. As (continues Mr. Playfair) I have never visited the London establishments, I shall confine myself in my description to the Scotch method; though I presume both are nearly the same. It is usual to allow the cows to pasture during the summer months, when the weather is propitious. Although the exercise thus received tends to diminish the quantity of butter in the milk, a greater flow of milk is really obtained; as their digestive apparatus is kept in a healthy state, and their appetite consequently increased. When kept in stalls they are fed upon grains, and allowed daily a few pounds of bean-meal. All the Scotch dairymen assured me that beans formed the most valuable food which they could give to stall-fed cows. The cows are permitted to drink as much *pot ale* (ale refuse) as they wish. Steamed turnips and potatoes are used as valuable additions to the precedingfood (*see post. p.*110).

"Now let us consider the theory of this method. Malt refuse contains starch, saccharine matter, a kind of mucilage, and a small quantity of albumen. The greatest part of the nitrogenous constituents have been removed; hence the grains do not contain substances fitted for an abundant supply of casein, but for the formation of butter and sugar of milk they are admirably adapted. The beans furnished to the cattle contain

* Chymia Medica, dogmatico-experimentalis.

casein ready formed, and therefore supply the deficiency in the previous food; while their starch and oil assist in the formation of the sugar of milk and butter. The pot ale serves to increase the flow of the milk. Pure water does not readily enter the blood. We know that it destroys the blood-globules; but acidulous water does not do so, and this pot ale is acid: it therefore enters the blood, and increases the flow of milk by diluting the secretions. It contains also alcohol, sugar, and starch, by means of which the respirations may be partly sustained, and the other food economised for the production of butter. The stalls in which the cows are kept are warm, and not too much exposed to light. The former economises food; and the latter condition does so likewise, by lulling the animals to repose.

"I have made a series of experiments in connexion with this lecture, in order to show the influence of food and exercise upon the secretion and composition of the milk of a cow. The cow was fed in the meadow and its milk analyzed, and afterwards brought into the stall; its milk being in like manner subjected analysis. The difference in composition was very marked; the milk obtained in the meadow contained more casein and less butter, to the amount of several per cent., than that taken from the same animal stall-fed. I then fed the animal upon various kinds of food, such as hay, potatoes, oatmeal, beans, &c., mixing these in determinate weights, and analyzed the milk of the cow fed upon such food.

"The details of the experiments are too numerous to bring before you on the present occasion, and I shall therefore publish them in a separate paper. I may merely state at present that the difference in composition was most marked, and fully bore out the manner of estimating the value of food which I have adopted. Beans were found to increase the quantity of cheese in the milk, as theory would lead us to expect, while steamed potatoes caused an abundant increase of the butter."

THE SUCKING CALF.

On the necessity and natural adaptation of the milk of the cow to the demands of the cow, Professor Lyon Playfair's observations (*Jour. R. A. S.*, vol. iv., p. 236) may be read with considerable advantage. He gives the following analysis of cow's milk, and deduces the subjoined observations on its composition and that of the ass:—

	Cow.	Ass.
	Playfair.	Peligot.
Casein	4·0	1·95
Butter	4·6	1·29
Sugar of milk	3·8	6·29
Ashes	0·6	..
Solid matter	13·0	9·53
Water	87·0	90·47
	100·00	100·0

The analysis of the milk of the cow is the average of several analyses of milk taken when the cow was in the field.

Casein, or cheese, is precisely the same in composition as animal flesh, and hence supplies matter adapted for the growth of the body. Butter and sugar are destined for the support of respiration, and consequent maintenance of animal heat. Butter is a substance admirably suited for this purpose; for, being of a combustible nature, it yields much heat by its union with oxygen. Sugar also is well adapted for the support of respiration. The ashes of milk consist principally of common salt and the earth of bones. It also contains potash and oxide of iron. The soda of the common salt is necessary for the formation of bile, whilst its muriatic acid aids in the process of digestion.

In milk, therefore, we find united all the conditions for the life of a young animal. Its rapid respiration, and the high temperature of its body, are supported by the butter and sugar of the milk. The casein furnishes matter for its growth, and the ashes the materials for the formation of the bones, and necessary constituents of the blood.

Casein, although of the same composition as vegetable albumen and gluten, differs from them materially in its properties. It is soluble in water, and does not coagulate by heat. Such properties obviously fit it for the nutrition of a young animal, in whom the organs of digestion are not yet matured.

The young ruminant, subsisting on the milk of its mother, does not require that complicated system of stomachs which afterwards becomes necessary for the proper comminution of its food. Accordingly we find that the aperture of the first and second stomachs is entirely closed, and the folds of the third adhere together, so as to form a narrow tube. The milk passes at once into the fourth stomach, which is the seat of true digestion. This arrangement of itself indicates that the food of the young animal ought to be liquid, even when it is deprived of the milk of its parent. It is for this reason that the weaning of a calf must take place very gradually.

There cannot be the slightest doubt that the future health and constitution of the adult in a great measure depends upon its judicious and generous treatment when young. Nature has pointed out to us, in the milk of the mother, not only the proper food of the child, but has exhibited also in it the model after which all food should be prepared. I do not mean that the adult should receive the various constituents of its food in the same proportion as the child, but that none of these constituents should be absent. In the milk of the cow the amount of unazotised matter, or of the part of milk destined for the support of respiration, is only about double that of the azotised portion, or of that part which forms flesh. In the food of adult cattle the proportion of the former to the latter is about six to one. But the unazotised constituents of the food of adults consist principally of starch, sugar, and gum; whilst those in the food of children consist of butter and sugar. The butter contains a very large amount of carbon and of hydrogen, and therefore a less quantity of it suffices to sustain the heat of the body than of any of the other substances now mentioned. Thus milk is actually better adapted for the support of the rapid respiration of a young animal than other kinds of food. The large proportion of casein in milk is obviously indispensable to furnish materials for the rapid increase of the body.

Any interference with the order of nature in the rearing of young stock is improper; but it sometimes occurs in England that calves are allowed to suck only for a few days, and afterwards are fed upon skimmed milk. In separating cream from milk we remove most of its butter, as well as part of the casein. Skimmed milk is therefore destitute of the principal ingredient destined by nature for the support of respiration and sustenance of the temperature of the body of the young animal. The proportion between the unazotised and azotised matter is completely altered, and the nutrition of the animal is placed in an unnatural condition. This is far from being an universal practice. The late Earl Spencer, to whose judgment on this point we cannot pay too high a deference, fed his calves for three months on unskimmed milk, and afterwards on skimmed milk, to which he added the meal of oats or of barley. He also found that sago forms an excellent mixture with skimmed milk for weaning calves: the sago, principally starch, forms an equivalent for butter. In this practice, which forms a striking contrast with the preceding, we find that, even when it is considered necessary to withdraw the butter from the milk, the proportion of food fitted for the support of respiration is compensated by the increased amount of unazotised matter in the meal with which it is mixed.

Although it is a very false economy to stint the allowance of food to a young animal, there may possibly be certain cases in which the same liberal allowance cannot be given, as in the case

now mentioned. The demand for milk has made the farmer very desirous to discover certain substitutes for that valuable fluid. The late Duke of Northumberland prepared skimmed milk with treacle and linseed oil-cake; and it is stated that this mixture has been found to succeed (*Dickson's Practical Agriculture*, vol. ii., p. 987). Here the sugar in the treacle, with the fat and gum of the oil-cake, served to compensate for the cream removed from the milk. Cream, however, contains also a quantity of casein, which is not supplied in this mixture. Bruised flax-seed (*Annals of Agriculture*, vol. xxiii.) and an infusion of hay (*New System of Husbandry*, vol. iii.) have been added to skimmed milk for a similar purpose.

On this subject it may be worthy of remark that the only kind of food in which casein exists is that derived from leguminous plants, such as beans, peas, and lentils. When bean-flour is softened and ground up with water, and the infusion passed through a sieve, the water is found to contain casein, fat (butter), and starch. The latter deposits by standing; and the infusion has now all the characters of skimmed milk, as in fact, with the exception of sugar of milk and butter, it is precisely identical with it. The addition of some fatty and gummy matter (as an infusion of linseed-cake) would more nearly approximate it to the composition of ordinary milk. And it is well worthy of remark, that in several districts of England, and in many of Scotland, pea or bean soup is very frequently given to young calves.

THE DAIRY.

THE COW-HOUSE AND DAIRY.

The construction, arrangement, and careful managment of the dairy, demand the young cow-keeper's very serious and even watchful attention. If these are neglected it is in vain that good cows are selected, abundant food supplied, or the utmost skill of the farmer excited. When he has done all in his power, useless and unprofitable will be all his skill, if the dairy-maid neglects her duties, or the mistress of the house fails to ensure regularity and precision in the routine work of the dairy. It is, then, most desirable that the owner of the dairy should be aware of all the practical results obtained by the experience of ages in the most celebrated butter and cheese dairies, and learn the chief points of difficulty experienced in most dairies. This, then, shall be the subject of this section; and if towards the conclusion I add a few chemical facts, observed in this great branch of rural economy, it will be, not with the hope of giving complete explanation of the various sometimes mystical difficulties so familiar to every dairy-maid, but rather as mere helps or first

approaches to a more advanced state of knowledge. As I have had occasion to remark in another place (*Farmer's Encyclopædia*), the dairy should be situated, if possible, on a dry porous soil. The room should be made of brick or stone, with a floor of the same materials, for the sake of its being more readily and frequently washed with cold water, not only on the score of cleanliness, but that the temperature of the place may in summer be kept down to the most advantageous degree. And, with this object, the dairy is commonly placed on the northern side of the house, where it may be readily shaded from the sun by other more elevated buildings, or by trees. A temperature between 50 degs. and 60 degs. is the best, and the less occasion there is to reduce the temperature of the dairy by washing the floor with cold water the better, since, amongst other disadvantages, the damp air thus produced is not so advantageous as a dry atmosphere for the retention of sweetness in milk and cream (*Farm. Rep.* p. 30); and, therefore, the dairy-house is often covered with thatch, and can hardly be too well ventilated. It should be far removed from stagnant ponds and offensive drains; and furnished with wire gauze windows, by which insects are readily excluded without impairing the necessary ventilation. Adjoining to it is placed a wash-house, furnished with a chimney, and a large copper kettle to heat the water, or in cheese dairies the milk. This is commonly supported by a crane.

The wash-house should have an outer door, near to which the dairy utensils may be set on benches, to be dried by the sun and air. In Holland the dairy rooms are kept with the greatest order, neatness, and comfort (as we shall presently see), so much so, that the farmer's family often take their meals in them. On the economy of the dairy the following excellent directions, abridged from those drawn up by the Agricultural Society of Aberdeenshire, may be studied by the farmer with advantage:—

1. The milk-house or dairy should have no internal communication with any other building. It must be kept free from smoke, well aired, and clean, and no potatoes, fish, onions, cheese, or anything likely to impart a strong or bad smell, should be kept therein; in short, nothing but the dairy utensils, which must also be kept sweet and clean. 2. The milk when brought in from the cows should be strained through a fine hair searce or drainer, and when cool put into sweet, well seasoned oaken cogs, keelers, or milk pans, the latter to be preferred. A tin skimmer with holes in it is the best for taking off the cream, which should always be churned while the cream is fresh. 3. The churn, whether plunge or barrel, should be made of the best well-seasoned white oak, and as cleanliness is of the first importance, great attention should be paid to the washing, drying, and airing of the churns immediately after use, otherwise they are sure to contract a sour and unwholesome smell, which must injure the quality of the butter. 4. The butter *immediately*

after being churned should be thrown into fresh *spring water*, where it should remain one hour at least, that it may grow *firm*. 5. The butter should be *immediately* salted. 6. It is a very injurious practice to keep a making of butter uncured to the next churning, for the purpose of mixing the two together. It invariably injures the flavour of the whole, and renders it of too soft a quality ever afterwards to get firm. 7. The milk of new calved cows should never be set for butter, until at least four days after calving, as a small quantity of biestmilk butter will injure a whole firkin. The practice of scalding cream in cold weather should also be avoided, as cream thus treated will never make good butter. 8. Great care should be taken not to steep the firkin or other dairy vessels in boggy or unwholesome water, only the purest spring or clear running water should be used. 9. Old butter should never be mixed with new.

The lime tree yields, perhaps, the best wood for butter firkins. And the St. Ubes Bay or marine sweet salt, free from bittern, is the best salt to use for dairy purposes. This should be kept in a dry clean cask, in a place where smoke (which is apt to impart a bad flavour to it) cannot reach it.

The mode in which the dairies are conducted in the Netherlands is every way worthy of our attention. This was some time since thus described by the late Rev. W. Rham (*Jour. R. A. S.*, vol. iii., p. 258); and though the account is mixed up with a description of the Dutch mode of feeding cows, yet I would not willingly omit any portion of so instructive a detail:

"The cows in Flanders are invariably kept in the stable, and fed chiefly on the produce of arable land. In summer their chief food is clover, vetches, or barley cut green. In winter they are fed principally upon roots, such as carrots, turnips, and potatoes.

"These roots are chopped up together in a tub, and some bean-meal, rye-meal, or buckwheat-meal, is added: boiling water is poured over this and allowed to cool; or the whole is boiled together in a copper, when fuel is not too scarce. Of this mixture, which they call *brassin*, two pailsful are given milk-warm, morning and evening, to each cow, and this is their food during the whole winter with a little wheat or barley straw. Hay is only given in a few districts, where the pastures are extensive, as about Furnes and Dixmude, but never in that unbounded quantity in which the cows eat it in England. Very little hay is made in any other district, and that only clover-hay, which is reserved for the horses when they work hard. Near the towns or large villages, where there are brewers, grains are added to the other ingredients of the brassin, and they greatly increase the milk.

"After comparing the accounts given in a variety of places and situations of the average quantity of milk which a cow gives when fed in the stall, the result is, that it greatly exceeds that of

our best dairy-farms, and the quantity of butter made from a given quantity of milk is also greater; an ordinary cow fed on young clover will give at three milkings, for the first three months after calving, from fifteen to eighteen quarts per day, which will produce 1¼ lb. of butter, that is, nearly 9 lbs. of butter per week. Where the number of cows is great, the average is much less, because, when there are only two or three cows, a deficiency in one of them is immediately noticed; the cow is got rid of, and a better one purchased. In a great number, there are always a few inferior cows, and a lower average is the consequence."

"In some parts of the Netherlands, as in Holland, the soil is better calculated for meadows than arable land, being low and flat, and necessarily intersected with many canals and ditches, in which the water stands very nearly on a level with the surface, and in some cases above it, being kept from overflowing the land by dykes of earth. In these meadows, especially in North Holland and Friesland, a very fine breed of milch cows and oxen is fed. The quantity of butter made for exportation, and its value in foreign markets, prove that the operations of the dairy are well conducted. The rich soil, no doubt, gives a good quality to the butter; but this is not the only cause of its superiority. The extraordinary cleanliness of every part of a dairy, and the constant and abundant use of water, the bright polish of the utensils wherever there is any metal, and the whiteness of the wood of the pails and churns, show the unremitted attention of the dairywoman. But the cleanliness is not confined to the place where the milk is kept. The stable, the cows, and even the litter, are kept so clean that it is a pleasure to walk through them; and the family often make one end of the cow-house their usual sitting-room, having a fire-place at one end, and always at least one comfortable bed for a labourer or servant, who always sleeps in the cow-house.

"The arrangement of a Dutch dairy is well known, and has been copied wherever any pleasure is taken in having fine and clean cows. It is the same in Holstein, from which much good butter is also exported, and where a dairy establishment is called a *Hollanderey*, which shows its origin.

"The building is generally like a large barn, with a roof coming to within 7 or 8 feet of the ground, sometimes tiled or slated, but more often thatched with reeds, which make it warm in winter. Through the middle, from end to end, is a space 10 or 10 feet broad, paved with hard bricks, which are always kept washed and swept clean. The heads of the cows are placed towards this middle space, from which all their food is given to them, sometimes in a shallow trough, made of bricks, level with the ground, and sometimes a little raised, but always with a gentle fall from end to end, to allow of sweeping and washing, which is a daily operation, if not repeated after each time of

feeding. As straw is scarce, the cows lie on smooth bricks laid sloping, and slightly hollow in the middle; and their beds, if we may so call them, are made of such a length that when the cows stand their tails hang over a gutter to receive the dung and urine. The cleanliness is carried to such a degree that in many cow-houses there are pulleys and lines over them, with a weight at one end, the other being fastened to the end of the tail of a cow to keep it up, and prevent its dipping into the gutter behind. No sooner has a cow voided her dung or urine than the servant sweeps the gutter with a broom, and the dung falls into a recess or cesspool which communicates with a tank or reservoir. The gutter is frequently washed out, and the water, running also into the reservoir, serves to dilute the dung, which after a time is pumped up, and either carried in water-carts to the meadows, or mixed up with earth and the litter of the horses into a compost.

The cows usually come into their winter quarters in November, and are put out to graze in May if the weather is mild. When first the cows are let out into the meadows a piece of coarse cloth is put over their loins and tied round their bodies, to prevent the injurious effects of cold dews and fogs; when the air is warmer this is discontinued.

"The milk-room, or rather cellar, is almost invariably vaulted, and sunk somewhat under the level of the ground. The floor, which is laid with porous tiles, is always kept wet by continual washing, and the evaporation tends to keep the cellar cool in summer. The milk is brought from the cow-house in large brass vessels in the shape of the Etruscan water-cans. As the cows are milked the pails are emptied into these cans, which, when full, carry the milk without much shaking. When the milk-cellar is very near the cow-house the can is dispensed with, and the pails are carried at once into the cellar and emptied into deep earthen pans. In some dairies the milk is set in shallow tubs or pans, as in England, but in most of them this is not the case. Each milking is kept separate; and when the milk is three or four days old, and becoming slightly acid, it is poured into a large upright churn, of which the plunger is worked up and down by means of a crank and machinery moved by a horse. In some smaller dairies a dog runs in a wheel, and by his weight causes the motion. In private families the servant churns the butter by means of a lever which works like the handle of a pump, and moves the plunger up and down, as is done with the bucket in the pump. The butter is usually taken out of the churn on a sieve or cloth, which lets the buttermilk run through; it is worked with a very cool hand, and salt is added as soon as all the buttermilk is pressed out. This is essential to its keeping quality; and no Dutchman would touch butter which had no salt in it, however fresh it might be. The butter made in summer when the cows feed in the pastures is of a very fine golden colour and agreeable taste. Where the pastures are not so rich

this colour is sometimes given artificially by means of scraped red carrots put into the milk, or by annatto-root, as is done with cheese in England; but the natural colour of the best butter cannot be imitated, and none but the inexperienced are deceived.

"The salt used in curing butter, as well as fish, is of a peculiar quality. It is crystallized in hollow pyramids composed of minute cubes. This is effected by allowing the salt to crystallize very slowly. Sea-water is boiled to a certain degree of saturation; and the boiling is continued very slowly, so that the muriate of soda separates from the other salts. The crystallization generally begins at the surface of the water by the formation of a cube surrounded by a rim of cubes forming a hollow inverted pyramid, which increases along the outer edge till the crystal becomes too heavy to float, when it falls to the bottom. It is nearly pure muriate of soda, and very little deliquescent. This salt is dried in an oven, and then pounded, and ultimately worked into the butter. The casks in which the butter is packed for sale are made of very white clean wood. The inside is well-washed with strong brine, and the butter is pressed closely into it. A cask must be filled at once, and, some salt being strewed over the surface, the head is put in, and it is ready for exportation. The pasture, no doubt, gives the richness to the butter; but it is the extreme attention to minute particulars, and especially the extraordinary cleanliness of everything which is connected with the dairy, which gives the Dutch butter its great reputation.

Cheese of various kinds is made in different parts of the Netherlands. That which is the best is a new-milk cheese called *Gouda cheese*, from the name of the town in Holland near which it is made. The little round Dutch cheeses, which are exported in great quantities for ships' provision, are made in the neighbourhood of Edam: some of the cream has been subtracted and made into butter, and the cheese is what would be called half-meal cheese in England. It is very strongly salted, by soaking it in brine. It is said that the curdling is produced by muriatic acid instead of rennet; but this is not generally the case. The common skim-milk cheeses made in Holland have seeds of cummin mixed with the curd, and are made of the size of our Cheshire cheeses. It is but a poor cheese, and seldom exported. When it is grown hard it is cut into very thin slices, and usually put upon bread and butter; thus the poorness of the cheese is corrected, and the cummin gives a flavour which habit makes agreeable. Buttermilk forms a considerable part of the food of labourers and mechanics, as well as of children. They make a kind of soup of it by boiling shelled barley in it, and sweetening it with treacle or sugar. It requires early habit to relish this mess, it is both nutritious and wholesome to those who like it.

Very large oxen are fatted in the rich meadows of North Holland. They have large bones, and in some points would not

satisfy a judge of a Smithfield show. But it must be recollected that milk is the chief object of the breed, and that good milch cows are invariably deficient in some points considered essential in a perfect ox reared only for fattening. The meat of the oxen which are killed in Holland is excellent, and when salted makes the best of ship provisions. Sometimes they are fatted with oil-cake, and many with the wash from the distilleries; but in general they are simply fatted on hay and grass, which make by far the best meat."

MILK AND BUTTER.

The quantity and quality of the milk are influenced by several causes; such as the breed of the cow, the period which has elapsed since her calving, the season of the year, and the quality and variation of the food. It has been calculated that the average daily yield of milk by the cows of Devonshire is about twelve quarts; Cheshire, eight quarts; Lancashire, eight or nine quarts; and this is perhaps about the average of an ordinary cow (*British Husbandry*, vol. ii., p. 403). The milk of a cow seems, according to the experiments of M. Boussingault, an eminent French chemist and farmer (*Quart. Jour. Agriculture*, vol. x., p. 344), to be the richest in cheese directly after calving. The following table contains the results of his laborious trials. They evince a gradual falling off in the produce of milk from the time of calving, and the quantity of the produce in the cow of M. Boussingault seems never to have been large. (A litre is rather less than an English quart).

First Series of Experiments.—COUNTRY COW.

No. of Days since Calving.	Milk given in 24 Hours.	Food given equivalent to about 30 lb. of Hay.	Composition of Milk.				
			Cheese.	Butter.	Sugar of milk.	Salts.	Water.
	Litres.						
1	5·0	Potatoes, hay . . .	15·1	2·6	3·6	0·3	78·4
13	7·5	Ditto					
24	10·6	Hay, green clover .	3·0	3·5	4·5	0·2	88·8
35	12·0	Green clover . . .	3·1	5·6	4·2	0·3	88·9
200	5·6	Hay	3·0	4·5	4·7	0·1	87·7
207	6·0	Turnips	3·0	4·2	5·0	0·2	87·6
215	5·6	Red beet	3·4	4·0	5·3	0·2	87·1
229	5·0	Potatoes	3·4	4·0	5·9	0·2	86·5
240	3·6	Hay					
270	3·4	Potatoes					
290	3·5	Jerusalem artichokes	3·3	3·5	5·5	0·2	87·5
302	2·8	Hay and oil-cake .	3·4	3·	6·0	0·2	86·8

Second Series of Experiments.—Swiss Cow.

176	9·3	Potatoes, hay . . .	3·3	4·8	5·1	0·3	86·5
182	8·9	Hay, green clover .	4·0	4·5	4·0	0·3	87·2
193	9·8	Green clover . . .	4·0	2·2	4·7	0·3	88·8
204	7·8	Clover in flower . .	3·7	3·5	5·2	0·2	87·4

Milk is composed then of cream, curd, and whey; the cream and the milk being merely united mechanically, new milk when allowed to rest, the cream being the lighter of the two rises gradually to the top; the curd, or cheese, too, separates from the milk with a very slight degree of acidity. Butter may be made by the agitation of either cream or new milk: fresh cream is not commonly used because it generally requires four times the churning that stale cream does. Cream was found by M. Berzelius to contain in one hundred parts—

Butter	4.5 parts
Cheese	3.5 „
Whey	92.0 „

and he also ascertained that when milk is deprived of its cream, 1,000 parts contain of—

Water	928.75 parts
Curd, with a little cream	28.0 „
Sugar of milk	35.0 „
Muriate of potash (chloride of potassium)	1.7 „
Phosphate of potash	0.25 „
Lactic acid, acetate of potash . . .	6.0 „
Earthy phosphates	0.3 „

From some valuable experiments on the temperature at which butter may be best procured from cream, by Dr. John Barclay and Mr. Allen, it appeared "that cream should not be kept at a high temperature in the process of churning: in the experiment when the temperature was lowest, the quantity of butter obtained was in the greatest proportion to the quantity of cream used, and as the temperature was raised the proportional quantity of butter diminished; while in the last experiment, when the mean temperature of the cream had been raised to 70 deg., not only was the quantity of butter diminished, but in quality it was found to be very inferior, both with regard to taste and appearance. The conclusion to which they came therefore was, that the most proper temperature at which to commence the operation of churning butter is from 50 deg. to 55 deg., and that at no time of the operation ought it to exceed 65 deg.; while on the contrary, if at any time the cream should be under 50 deg. in temperature, the labour will be much increased without any proportional advantage being obtained, and a temperature of a higher degree than 65 deg. will be injurious as well to the quality as the quantity of the butter (*Trans. High. Soc.* vol. i. p. 194). One of these experiments it may be well

to abridge. Fifteen gallons of cream at the temperature of 50 deg. were churned; each gallon (equal to holding 8 lbs. 4 oz. of water) weighed 8 lbs. 4 oz.; by churning for two hours, the temperature of the cream rose to 56 deg.; at the end of the churning it was 60 deg. The butter obtained weighed 29½ lbs. avoirdupois, or nearly 2 lbs. for each gallon of cream; the butter firm, rich, and pleasant. A gallon of the churned milk weighed 8lbs. 9 oz.

The method of making the best butter all over the dairy district of Scotland is thus described by Mr. Aiton (*Quart. Journ. Agr.* vol. v. p. 351.):—The milk when drawn from the cow is placed from six to twelve hours in coolers, the same as when set aside to cast up its cream; but this is merely to let the milk cool; and whenever it is divested of its natural heat the whole meal of milk is emptied from the coolers into a stand vat or tub sufficient to contain the whole. If the vat is large, and a second meal of milk has become cold before the former meal of milk has begun to acidify, the second may be turned into the first. It is then placed in a vat, covered over, and allowed to remain undisturbed, till the milk has not only acidified, but until it has been formed into a coagulum (or *lapper* in dairy language). It is now ready to be churned, and provided the lapper is not broken (which makes it ferment) it may remain, without injury, unchurned for some days.

Milk prepared in this way is churned in upright or plunge churns, of a size to suit the magnitude of the dairy. Where only a few cows are kept, the churns will hold about 100 quarts, from 200 to 240 quarts, and some still more. These large churns are on some large farms moved by machinery of various constructions; but in most dairy farms, churns of 200 quarts are wrought by hand labour only. After the clotted milk is put into the churn, as much hot water is poured amongst the milk as to raise the temperature from 50 deg. or 55 deg. (the temperature of the milk-house) to 70 deg. or 75 deg., one person agitating while another throws in the water. The temperature must be raised to or above 70 deg. before the butter can be separated from the milk; and this cannot be accomplished in any way so well as by pouring in boiling water after it has begun to be churned. If the milk is too cold, when churning it swells, has a pale white colour, throws upon the surface many air bubbles, and emits a rattling noise; the time of churning is from 2¼ to 2¾ hours; the milk being of ordinary quality; 24 pints imperial yield 24 ounces of butter.—(*Farmers' Encyclopædia.*)

To those to whom the labour of churning (as in small establishments) is very objectionable, various modes of accelerating the coming of the butter may be adopted; the addition of a small portion of vinegar to the cream will effect this very speedily. Another mode is that followed in Devonshire: the milk of the meals of the previous day is placed in a tin pan over a gentle fire,

and heated till it almost simmers, this will be in about three quarters of an hour; it is then allowed to cool for twelve hours. The thick part, or cream, is then skimmed off (this is the cloutted cream of Devon), and when a sufficient quantity is collected (perhaps during two or three days), it is made into butter. The right degree of heat (which is important) will soon be learnt by the dairymaid by one or two trials; it is indicated by small bubbles appearing in the cream when a portion of it is removed from the fire, and placed either in a churn or bowl (of wood is the best), and then by a very short agitation the butter almost immediately comes.

The following is a statement of the comparative quality of milk from eight Alderney and eight Kerry (Irish) cows, upon the farm at Oakley Park, in May, June, July, and August, 1840, by Mr. R. White, tested from a lactometer holding one pint of milk, and divided into 100 parts by index.—(*Jour. R. A. S.*, vol. ii., p. 420.)

Cows.	Portion of Cream in 100.	Difference.
May. . . Alderneys . . .	25	
„ Kerrys	10	
		15
June . . Alderneys . . .	20	
„ Kerrys	10	
		10
July . . . Alderneys . . .	23	
„ Kerrys	10	
		13
August . Alderneys . . .	16	
„ Kerrys	13	
		3

Butter churned from three pints of cream from each:—
Alderneys . . 1 lb. 8½ oz.
Kerrys . . . 1 lb. 4½ oz. } 16 oz. to the pound.

A great district of Continental Europe, that of Holstein, is celebrated for its dairies, and the butter they produce. These have been thus graphically described by an English gentleman, long settled there as a large farmer. In reading his interesting and instructive detail, the English reader must remember that the climate of Holstein is much colder in winter and warmer in summer than in our island, and that however large the dairies here described may be, yet still most of the good principles followed in them may be readily adopted in the smallest dairy.

The pride and boast of the Holsteiner, says Mr. J. Stanley Carr (*Jour. R.A.S.*, vol. i., p. 376), is his dairy; and the fame of Holstein butter, which, if we except that made in Holland Proper (or Delfland), may well claim to be the best in the world, not only justifies his preference, but may render a sketch of those

peculiarities of management, by which the Holstein dairy system is more especially distinguished, neither uninteresting nor useless to the English farmer. These may be chiefly classed under four heads; viz., the buildings and utensils; the time of milking, and number of hands employed; the management of the milk; and the mode of working, salting, and packing the butter.

The buildings indispensable to a large dairy (which varies from 100 to 400 cows) are, a milk-cellar, a butter-cellar, a churning-house (and closely adjoining the horse-mill by which the operation of churning is invariably effected), a cheese-room, and a kitchen, in which not only the various utensils are washed, but the food cooked for all the persons immediately engaged in the dairy-work; to which must commonly be added their sleeping and eating apartments, as, on large estates, the whole of the establishment is usually kept apart from the mansion-house. The size and site of the milk-cellar are esteemed matters of first-rate importance: it ought to front the north; be shaded from the southern sun by rows of trees—elder being especially selected for this purpose, and indeed placed if possible near the windows, on account of their influence in keeping off the insect tribes; and a thatched projecting roof is preferred, affording greater protection from the heat: while, in choosing the site, peculiar care is taken to place the dairy beyond the reach of everything calculated to generate bad odours, or in any way taint the atmosphere. The size of the milk-cellar must necessarily be regulated by the number of cows, but it should always be calculated to contain the produce of four milkings; and as the milk-dishes usually occupy a space of two feet square, the produce of 100 cows, giving on an average 8 quarts per day (a large average for the cows of this country throughout the year), would fill 50 milk-dishes at each milking, and would require a ground surface of 500 square feet, as the milk-dishes are invariably placed on the floor, the amount of each milking a little apart; and there must unavoidably be spaces left, to enable the dairy-maids to go through their various operations of skimming, sieving, and removing cream, &c. The floor, though sometimes flagged, is more generally of brick, neatly fitted, so that no water may lodge in the joints; and always gently inclined, with a grated opening at the lower end, to facilitate the mopping and washing of the floor, which is never omitted to be done twice a day, notwithstanding that every avoidable impurity is carefully guarded against, and every drop which may fall at the time of the milk being strained is instantly wiped up. A great improvement has been recently made in some newly-arranged dairies, by dividing the floor into compartments with brick ledges, from three to four inches high, between which the milk-dishes stand; and the compartments (the lower extremity of which is fitted with a small sluice) being filled, by means of a pump, with cold water twice a day, the milk is preserved so cool

as to prevent all approach to acidity for several hours longer than when placed on a dry floor; thus affording, even during the summer solstice, sufficient time for a complete separation of the milk and cream, without which the full proportion of butter cannot be obtained. For effectuating the same desirable result, ice is frequently resorted to in sultry weather, either by dropping a piece of pure ice in each milk-pan, or by placing a pailful in the dairy, which, by giving off its cold, sensibly lowers the atmospheric temperature.

It is considered necessary that the milk-cellar should be sunk from 3 to 4 feet in the ground; be from 16 to 18 feet high (the best have an arched roof, as being more conducive to coolness than boards); and be furnished with two rows of windows, (and, if possible, on three sides, north, east, and west,) to secure a thorough air. The lower range consists of wooden trellis-work, provided inside with gauze frames to exclude insects, and outside with hanging shutters, which can be lowered and elevated at pleasure. The upper range is furnished with glass sashes when light only is requisite, which are exchanged for gauze frames, when more coolness is desirable. The butter-cellar also must be light, airy, and cool; being likewise sunk in the ground, and the same precautions adopted as in the milk-cellar, to secure an abundant current of pure air. In it the butter, when carried from the churning-house, is worked, salted, and packed; and the filled butter-casks ranged on clean boards, somewhat elevated above the floor to admit a free passage of air, are weekly turned and wiped.

Next in order comes the churning-house, which differs in no respect from similar arrangements in England, excepting that, of late years, the perpendicular movement of the churn-staff has been exchanged for the rotatory,* which is found to churn in a shorter time, and with less risk of producing, even in hot weather, what is called oiling.

The cheese-room is never admitted near either milk or butter-cellar, and is, in newly-arranged dairies, placed as far as may be from them. In fact, as cleanliness forms the great object of the Holstein dairy system, the closest attention is paid to guard against every impurity, and to remove everything from the vicinity of the dairy which could, by possibility, exercise a sinister influence on the very susceptible *substances of milk and butter; which suffer, to a degree those unaccustomed to observe it would little suspect, from a tainted atmosphere.* As the preparation of cheese is better understood in England than here, I will only mention that three sorts are made—sweet milk, skimmed milk, and occasionally what is termed cream cheese; and shall now proceed to describe the management of the milk, first enumerating the number of persons required. These consist, in large dairies, of a meyer or overseer, a cooper, one or two cow-herds

* Seventy-two revolutions per minute.

(as may be requisite), one or more swine-herds, an upper dairy-woman, and dairy-maids in the proportion of 1 to every 18 cows. The overseer's duty involves a general charge of the cattle, whether in health or sickness, with a competent knowledge of their diseases and the remedies; he is responsible for the swine being properly cared for; that the calves, whether fatting or rearing for stock, are regularly and suitably fed; that the cow-herd does his duty; that the hours of milking are punctually adhered to; and that everything and every person is in proper place and keeping. He must further pay strict attention that the cows are milked thoroughly out, on which so very much depends; as not only the cow which is allowed to retain any portion of milk diminishes her produce by so much from day to day, but the last, being by far the richest part, a loss of butter is incurred, much more than proportionate to the quantity of milk, by this culpable negligence or laziness. According to the observations of an accurate examiner, Dr Schübler, the first drawn milk contains only 5, the second 8, and the fifth 17 per cent. of cream! If the number of cows be not above a hundred, the overseer can also undertake the cooper work; which, when wooden milk dishes are used, in addition to the cream-barrels, milking pails, and butter-casks required in the course of a year, is a consideration both of time and expense. But in large dairies, a cooper is kept in addition, who however must likewise milk a certain number of cows, assist in carrying the milk, feeding the cows when housed, or any other dairy-work which a man is capable of. The wages of these two persons vary according to the extent of the dairy, but may be averaged the first at 60, and the second at 40 dollars per annum.

The dairy-maids, besides milking, cleaning the vessels, &c., work in the garden in summer, spin in winter, and wash, bake, brew, and cook for their own establishment, under the superintendence of the upper dairy-woman, who is by far the most important personage in it, as on her skill, attention, and diligence depend, in great measure, both the quantity and quality, and, by consequence, the profit of the produce. She must not only thoroughly understand, but accurately observe, the moment when the milk should be creamed; the degree of acidity it must attain in the cream-barrels; its temperature, whether requiring the addition of warm or cold water to the churn, as well as the all-important operations of kneading, beating, salting, and packing the butter. She must not only be punctiliously clean herself in person and work, but keep a strict eye over the cleanliness and order of her subordinate maidens. In very large dairies the upper woman has full employment, without milking, and needs the assistance always of one, and sometimes of two, of the more experienced dairy-maids, in butter and cheese making; but in smaller establishments she milks a certain number, generally 10 cows, while each of her subordinates have

18; her wages are usually 55 to 60, that of her chief assistant 22, and that of the others 18 dollars per annum.

During summer the dairy people must rise at three, and even two in the morning, if the weather be very hot; for which they are indemnified by two hours sleep, from 1 to 3 in the afternoon. At 4 they commence milking, which takes place in the field, and generally occupies two hours. At the beginning of the season each girl marks her own cows by tying a particular coloured ribbon round their tails, and in some places they adopt the precaution of the milkers carrying a string on which they cast a knot as each cow is successively milked, thus securing against one being forgotten. As the fields are large, and often at a great distance, the transport of the milk is facilitated by the very simple contrivance of a long, low, four-wheeled, one-horse waggon, in the side bars of which strong iron hooks are inserted, at such distances that the milk-pails, containing from 30 to 40 quarts each, may swing free of each other, and these, though filled nearly to the brim, are prevented spilling, notwithstanding many a rude jolt over the rough, and often deeply-rutted road, by merely having thin pieces of wood, about the size of a dinner-plate, floating on the surface; a practice, indeed, universal in these countries, when pails with any liquid are carried even in the hand. The milk when brought to the dairy is immediately strained through a hair sieve into the vessels, whether of wood, earthenware, copper tinned, zinc, cast-iron (lined with a china-like composition), or glass, placed in rows on the floor. All these different kinds of utensils have been tried with various success, in the hope of discovering how, in hot weather, more especially when a thunder-storm is gathering, the milk can be guarded against a too early acidity; for, as it is a fixed and invariable rule, the cream must be removed from the milk before the latter gets at all sour, and an equally established fact that all the oily particles cannot be obtained in a shorter period than 36 hours, vessels in which, during sultry, and especially damp weather, the milk could be kept the due time, are a great desideratum. As yet, however, there reigns much diversity of opinion on the subject, and shallow wooden vessels, as nearly as possible equally wide at top and bottom, containing when full about 8 quarts, but in which during summer seldom more than 6 quarts are poured, are in most general use. They have, however, some disadvantages, of which the chief is the great difficulty and the consequent labour and close attention requisite to remove all acidity (which in some states of the atmosphere is almost unavoidable), and which, penetrating the pores of the wood, sometimes resists all the patient scrubbing—first, with hot water and small birch scrubbers, and secondly, with boiling water and a hard round brush made of pigs' bristles (with which every hair's-breadth is carefully polished over), so that the despairing dairy-maid is compelled to resort to washing in a ley of wood

ashes, or boiling, or even scorching over lighted chips, followed by countless rinsings in pure spring water. To diminish in some measure this labour, the plan of painting the milking pails and dishes with a preparation of cinnabar, linseed oil, and litharge, has been adopted by the milk-venders in towns, and in some country dairies: not only, however, is the expense considerable, as the vessels must be finished off with peculiar care, and require to get three coats of the composition at first, and one yearly afterwards, but the milk for some days after they are brought into use has a perceptible taste of paint. The tinned copper milk-pans are very costly, and must be carefully watched lest they should require re-tinning. The zinc are as yet little known, and the assertion of their effect in better severing the cream from the milk not sufficiently proved. The cast iron, lined with enamel, though assuredly durable and very clean, seem too expensive; and the glass have many opponents on account of their brittleness, and the vague notions respecting glass and electricity inducing the idea, that if the electric fluid get into the milk, it cannot get out again! whereas, as it is ascertained that it always attaches itself to a conductor, and, in the absence of anything more attractive, runs along the surface, it is more likely that the milk should be protected in glass, which is a non-conductor, than in any other substance. In my dairy, which contains upwards of 180 cows, the glass vessels have been used for four years; and I give them a decided preference over all others. Their form is good, being 16 inches broad at the top and 12 at the bottom: the glass is dark bottle-green, transparent, and perfectly smooth, about one-eighth of an inch thick, and provided with a rounded rim at the upper edge, which makes it easy to retain a safe hold of them, even when full. They contain 8 quarts, but never receive more than six. They cost 8d. a-piece, and their durability may be estimated by the fact, that to encourage carefulness, each dairy-maid is allowed one dollar per annum extra, as *pan money*, being bound at the same time to pay 10d. for each one she breaks, yet hitherto no girl has broken to the extent of her dollar. It is self-evident that acidity cannot be communicated to glass, and the ease and rapidity with which they are cleaned, requiring merely to be first washed with luke-warm water, then rinsed in cold water and placed in a rack to dry, effect such a saving in fuel and labour (diminishing the number of our dairy-maids by at least two), that the less quantity of butter obtained, supposing (which I by no means concede) that the milk, during a few weeks in summer, does sour sooner, and consequently throws up less cream in glass than in wood, is more than compensated by the lessened expense of the establishment, not to mention the great advantage of attaining the indispensable cleanliness and purity of the vessels, with more certainty, because at a less expenditure of time and trouble. Although it is an ascertained and undeniable fact that

the quality of butter depends much on the nature of the pasture, the locality of the dairy, the universally prevailing cleanliness of the whole management, and *very* essentially on the purity of the water employed, still I ascribe much of the reputation which our butter has of late years enjoyed (and which is verified by our obtaining at all seasons one penny per pound above the market price in our neighbourhood) to the beneficial introduction of glass milk-dishes. It is further to be observed that, if occasionally a small portion of cream should remain incorporated with the milk, the loss is not total; being either redeemed by the additional goodness of the skimmed milk cheese, or at worst, enjoyed by the rearing calves and swine, which must ever bear a proportion to the cattle kept. Ten calves per 100 cows is the estimated number necessary to be reared as stock, if purchasing, to supply the yearly deficiencies occasioned by age and disease, is to be avoided. It was communicated to me by the late Mr. Handley that the proportion of 10 per cent. yearly for cast cows appears very low. My sketch of our dairy husbandry is for the purpose of telling *what it is*, not what it might be. The remark is fair enough from any one accustomed to English farming, in which the outgoing cows are fattened for the butcher on turnips; and there can be no doubt that this is the most profitable mode, always presuming that there are turnips, or some such cheap nutritious food, in abundance; but, with the exception of my own farm, and of those where there are potato-distilleries (as in Prussia), there is nothing of the sort. It is, therefore, universally the practice to keep a good milch cow, so long as she can eat her dry winter food, *i. e.* whilst her teeth are sharp: such a cow is often kept till she is 14 years old, and a younger, but worse milker, turned out in her stead. These old animals are then sold to the poorest people for little more than the value of their skin. The statement, therefore, that 10 per cent. is the average renovation of our dairy stock is correct.

It has already been stated as a rule, that the cream must be removed from the milk before any acidity is perceptible, if butter of first-rate quality is looked for; and it has been found by experience, that a cellar temperature of from 60 deg. to 62 deg. Fahrenheit is the most favourable; a complete disseverment of the cream then taking place in 36 hours: whereas, a greater degree of warmth, though it quicken the separation, still more hastens the souring process, which operates injuriously not only on the quality, but the quantity of butter. In a cold temperature the separation is effected much more slowly, so that 48 or even 60 hours may be required: this, however, is the longest period that may be accorded without incurring the risk of imparting a rank unpleasant flavour to the butter, which even, if not perceptible on its being first churned, manifests itself very shortly afterwards.

The commencement of acidity in milk is indicated by a very

slight wrinkling of the cream, and a scarcely perceptible acid taste. So soon as these signs appear, the work of skimming must begin, even though the milk have only stood 24 hours; and the cream is poured through a hair-sieve (which is kept for this purpose, and must never be used to strain up the new milk with) into large barrels, containing about 240 quarts each (usually sufficient for one churning), in which it remains till the necessary sourness is attained, which in summer follows in 24, in winter seldom under 36 or 48 hours; unless when the small quantity of milk admits of it being partly strained at once into the cream barrel, and the remainder added without skimming from the milk-pans when cool. This method, undoubtedly, gives at all seasons the greatest return of butter, but as is generally believed not of so rich a quality as that produced from cream alone; and, moreover, in a large dairy, during the time the cows are in full milk, would occasion much additional trouble, an almost ceaseless churning, and a total prevention of cheese-making. The cream having attained its requisite acidity, during the advance to which it must be frequently stirred with a small churn-staff to prevent it coagulating, technically called becoming cheesy, the next object of the dairy-woman's skill is, the degree of warmth or coolness which must be imparted in order to secure good butter. In warm weather the churn is rinsed with the coldest procurable water, in which a piece of pure ice is often thrown, and sometimes, though more rarely, cold spring water is added to the cream about to be churned, which operation is then always performed either very early in the morning or late in the evening. In cold weather, on the contrary, warm water is applied, both to rinsing the churn and to the cream itself. The churning being completed, the butter is taken off by means of a large wooden ladle, and carried in a tub directly to the butter cellar, where, in a large trough, hollowed out of the trunk of a beech or oak, very smoothly polished off inside, and provided with a plug-hole at the lower extremity (beneath which a small tub is placed to receive the expressed milk), the butter is slightly worked, and salted with the purest salt,* then moulded with the wooden ladle into a mass at the upper end of the trough, and left for some hours to soak and drain. In the

* The purity of the salt is no doubt of great importance in the preparation of butter for the market. Throughout Holland, as well as in these districts, it is refined by skilful means of evaporation, and the greatest care is employed in making it; the best being understood to be made from sea-brine. Here it is almost invariably manufactured either from pit-brine or rock-salt, without attention to anything but its strength; and our dairymen, we believe, make use of whatever salt they can procure, without knowing or caring for any difference in its quality; in consequence of which the Dutch butter, though not intrinsically worth more in its natural state than the Irish, always fetches more money.—F. BURKE.

evening it is thoroughly kneaded and beat, or rather slapped, the dairy-maid repeatedly lifting a piece of from 3 to 4 lbs., and slapping it with force against the trough, so as to beat out all the milky particles; and thus, lump after lump being freed from extraneous matter, the whole mass is spread out, receives its full proportion of salt (in all about ½ oz. per pound), which is worked with the utmost care equally through it, and again moulded into one compact mass. The butter in Holstein is seldom if ever washed: as water is believed not only to rob it of its richness and flavour, but as being itself susceptible of putrefaction, to be equally inimical as milk, to its preservation. When a sufficient quantity is ready to fill a cask,† the several churnings are once more kneaded through, a very little fresh salt added and packed into the barrel, which is made of red beech-wood, water-tight, and previously carefully washed and rubbed inside with salt. Much attention is paid that no interstice shall remain either between the layers of butter or the sides of the cask. A cask is never begun to be filled until it can be completed, as thus alone the butter can be exactly of the same flavour and colour, which is probably one reason why small dairies, under whatever management, never produce such good butter as large ones, as the small churnings must remain long exposed to the air, until the requisite quantity is in readiness.

The qualities of first-rate butter are considered to be, 1st, a fine, even, yellow colour, neither pale nor orange-tinted; 2nd, a close, waxy texture, in which extremely minute and perfectly transparent beads of brine are perceptible; but, if these drops be either large, or in the slightest degree tinged with milk colour, it indicates an imperfect working of the butter, while an entirely dry, tallowy appearance, is equally disapproved; 3rd, a fresh fragrant perfume, and a sweet kernelly taste; 4th, good butter will, above all, be distinguished by keeping for a considerable time, without acquiring an old or rancid flavour.

The butter of Holstein and Schleswig is classed under the different names of fresh milk, May, summer, and stubble butter, according to the season in which it is produced. The first denomination given to that made in spring, between the time the cows calve and their being turned to pasture. The second designates that produced during the month of May, after they have been sent to grass, which, though highly prized for its peculiarly fine aroma when fresh, is found not to keep well, and therefore, like the fresh milk butter, generally sent to market as it is made. By summer butter is understood that obtained in June and July; from which time, till the cows are removed from pasture, the butter bears the name of stubble butter. Both the latter sorts, if properly made, keep well, and retain their fine

† Of these there are three classes, full-sized or tonne, containing 224 lbs.; half tonne, 120 lbs.; and thirds, from 106 to 112 lbs.

flavour almost unimpaired till the following spring; and therefore, although stubble butter generally speaking stands highest in favour, and consequently in price, yet, in well-managed dairies, the June butter is little, if at all inferior to it. The small quantity produced between the time of the cows being housed and their becoming dry, is called old milk butter, and is least of all esteemed.

The cow-house is, of course, in proportion to the number of cows, but generally twice as long as broad, and calculated for four rows lengthways, standing head to head, with passages between floored with brick, and furnished with feeding and drinking troughs. One passage, if not both, is broad enough to admit a loaded hay-waggon, and is provided with large folding-doors at each end, while there is also room behind the cattle sufficient to permit the manure being sledged out with a horse, without incommoding them. The lofty roof affords spacious accommodation for hay and straw, which is also considered useful in keeping the house warm in winter; for the same reason the doors are kept as much as possible shut, and sufficient light admitted by small glazed windows. The quantity of food which can be afforded to the cows during winter is ascertained at the beginning of the season, when the harvest returns are known; and, in plentiful years the calculation is, that each cow should be allowed 3 sacks of grain (generally oats of 140 lbs. each sack), 3,900 lbs. of straw, including bedding, and 1,800 lbs. of good hay; whilst for every hundred pounds of hay less, she must receive 25 lbs. of grain more, or *vice versâ*.

As during the winter months, when the cows are confined to dry food, the butter loses its fine yellow colour, the defect is sought to be remedied by an admixture of colouring matter; and indeed a high colour in butter so much regulates its price in some markets (as in Spain and Portugal) that the export merchant insists on the desirable shade being imparted when it ceases to be natural. The best ingredients for this purpose are found to be, a mixture of annatto and turmeric, in the proportion of 5 oz. of the latter to 1 lb. of the former. Annatto, however, is so often adulterated, that it may be well to mention some criteria by which to test its purity—a matter so much the more important, as butter is frequently much deteriorated by spurious annatto. When good it is neither very dry nor very damp (in the latter case it has generally suffered a degree of putrefaction); is of a bright and deep, but not dark red; should leave an orange shade when drawn along white paper, and possess a distinctly perceptible perfume, resembling that of violets. It is brought from South America, both in cakes and masses; the former (which is the best and dearest) are wrapped up in leaves, and weigh from 3 to 4 lbs. each; black traversing veins indicate a careless preparation, and the too common admixture of red earth, or pounded brick, is easily detected by dissolving a pi—

in water, when the heavy ingredients will be precipitated. The mode of using this colouring is by boiling the annatto and turmeric in butter for half an hour (stirring frequently), and then, being strained through linen, it can be kept for use. When butter is to be coloured, the quantity of this preparation required (which practice alone can teach) is melted over the fire, and poured into a hollow made in the mass of fresh-churned butter; then, by rapid stirring, intimately united with the butter immediately in contact with it, which, being then spread over the whole mass, is, together with the requisite portion of salt, carefully kneaded and worked through, until no particle remains more highly coloured than another; and when smaller portions have been thus coloured from day to day, before a cask can be filled, the whole must, before packing, be kneaded once more, that no disparity of shade may disfigure it.

The greater portion of the Holstein and Schleswig butter is bought up by the Hamburg merchants; though it is likewise sent in considerable quantities direct from Kiel and other ports to England, Copenhagen, and the West Indies.

There are three distinct breeds of cattle in the duchies: first, the native cow, which is by far the most common: it is middle-sized, not very long-legged, with fine head and horns, and moderately thick neck; the colour generally red or brown, though often yellow, black, and spotted. The cows of this breed decidedly yield more milk in proportion to the food they require, than any other in these countries; and the district of Angeln is much resorted to, as furnishing peculiarly fine specimens of the breed. Second, the marsh cows are much larger than the last-mentioned, and generally of a red colour, large-boned, and demanding luxuriant pasture; they are ill-suited to the interior of the country, but thrive well in the rich marshy delta of the Elbe, giving, when in full milk, from 24 to 32, or even 40 quarts daily; but the return of butter is much smaller, and of inferior quality to that obtained from the Angeln cattle, which likewise maintain their superiority when fatted, by fineness of grain and flavour. Third, the Jutland cow, frequently met with in the northern parts of Schleswig, is fine in bone, rather lengthy than deep in body, and not generally to be termed long-legged. The commonest colours are grey or dun, and black, or either of these spotted with white; very seldom red or brown. This breed, being more distinguished for fattening easily than for milk, is consequently little prized for dairy purposes.*

The average quantity of milk obtained here from good stock may be estimated at from 2,000 to 3,000 quarts per annum, ac-

* As in other countries, so here, much prejudice exists against innovations; hence occasional attempts to introduce a better class of milch-cattle have been hitherto without success, and the most general opinion is that improvement is impossible. Experience forces me, however, to a very different conclusion; as, by crossing the best

cording to the food and care bestowed on them, the produce of which has been calculated in the following ratio :—every 100 lbs. of milk will give 3¼ lbs. of butter, 6 lbs. fresh cheese, 14 lbs. butter-milk (exclusive of the water added before and after churning), and 76¾ lbs. of whey; and, though the qualities of individual cows, the nature of their pasture or other food, and the atmospheric changes, occasion an almost endless variety of result, still it may be considered as a fair *average* that 15 quarts of milk are required for a pound of butter; for, although from some cows a pound may be obtained from 12 quarts, yet others, and even the same cows, at different seasons and with different food (such as beet or raw potatoes), will not produce a pound of butter from less than 17 or 18 quarts. On the whole, it is esteemed a fair return in these duchies when the average produce of the dairy amounts to 100 lbs. of butter and 150 lbs. of cheese per cow. When calves are fattened for the market, so much butter and cheese cannot be expected—from the generally received opinion that fine veal (and the veal of these countries is very fine) can only be secured by feeding with milk fresh from the cow; they are usually fed for 10 or 12 weeks, and attain the weight of from 120 to 150 lbs. when slaughtered.

CHEESE-MAKING.

CHESHIRE.

In the management of a cheese dairy there is much matter that requires the owner's attention; I can hardly give a better detail of these than in the words, almost at length, of the process of making Cheshire cheese, given in his prize essay, by Mr. Henry White, of Warrington, in Cheshire (*Jour. R. A. S.*, vol. vi., p. 102). The following account of Cheshire cheese-making then, is from the essay of Mr. White :

It is scarcely necessary to repeat what we have noticed in previous pages of this work, that milk, from which cheese is made, consists of three distinct parts—*cream, curds,* and *whey*—into which, by repose, it spontaneously separates; but the process of separating the whey from the other bodies may, as in cheese-making, be accelerated by infusing a small quantity of a simple acid extracted from cured and dried maw-skins (the *stomachs of sucking calves.* See the method of curing these, post p. 109), which have been previously dissolved in warm water. This infusion is commonly called "steep," but more properly *rennet.*

country cows (principally from Angeln) with Ayrshire bulls, I have obtained a class of stock so greatly improved in the second and third generation, both in carcase and milk, as to warrant the expectation they they will, in the fourth remove, bear comparison with genuine Ayrshires.

The art of cheese-making consists in the complete extraction of the whey, and in the proper compacting and curing of the curd. The richness of the cheese depends upon the quality of the milk, or, in other words, on the proportion of cream which the milk contains. The cheese of Cheshire is professedly made from new milk, or milk from which no cream has been taken. It is, however, well known, that in many dairies, in the morning before cheese-making, a small quantity of cream is skimmed off the previous evening's milk; this cream is either churned by itself, or mixed with whey-cream, by which there is obtained a better quality and greater quantity of (so called) whey-butter. It may appear singular to some, that any portion of cream should be found in whey, but such is the fact, and the means used in Cheshire for extracting it are very simple (*see post* p. 108.)

Number of Cows kept, and Produce.—The number of cows kept for the purposes of a cheese *dairy* is seldom less than 8 or 10, or more than 70 or 80; and is of course regulated by the size of the farms—these average about 90 or 100 statute acres, upon each of which about 15 or 18 cows are kept. From 18 cows a cheese of from 36lbs. to 54lbs. weight is made daily during four or five months of the summer. The annual produce of cheese per cow depends both upon the quality of the animal (with the mode of keeping her), and of the *land*, or rather the *herbage*. I have known many farmers sustain great loss by not feeding their cattle sufficiently well in winter. With judicious management, about 3 cwt. of cheese (of 112lbs.) may be considered as the average amount made per annum upon land let for 30s. a statute acre; but in a few instances 5 cwt. per cow, and even more, is sometimes made. This can only be from a small and choice stock.

The Season.—It is the practice amongst farmers in this county to arrange so as to have most of their cows calving in the months of March and April; and so soon as the calves are fed or disposed of, the cheese-making commences, and continues (excepting in small dairies) to nearly the end of the year. In January and February the quantity of milk obtained is often so small that the farmer prefers selling it in the neighbouring towns or making it into butter. There are, however, instances, in large dairies (of 70 or 80 cows), of cheese being made throughout the year.

Milking.—The operation commences about five o'clock in the morning, and five or six in the evening. In this county it is the practice for most of the servants, both men and maids, to assist, and for the cows to be milked in the cow-houses (called here "shippons") all the year round. When, as is usual, there is one milker for every six or seven cows, the milking seldom exceeds an hour and a quarter. The milk of new-calved cows is not mixed with the other until about four or five days after calving.

Offices and Utensils.—As the evening's milk is seldom made into cheese until the following morning, and sometimes in small dairies (where four "meals" are used) not until the second morning, a cool "milk-house" is necessary; on which account it usually occupies that side of the farm-house least exposed to the sun. The utensils in which the milk is kept are usually portable shallow earthenware vessels called "pan-muge," and in some dairies leaden or zinc coolers. Most of the milk-rooms have lattice or wire windows for the circulation of air, and the floors are laid in a sloping form for the free escape of the cold water with which they are daily swilled throughout the summer months. If precautions of this nature be not attended to, there is a risk of the evening's milk becoming *sour*; in which case, whatever quantity of new milk be added to it in the morning, the cheese will be *sour* also. I am led to believe that a temperature of as near 50° Fahrenheit as could be maintained, would be best for a milk-house throughout the year. The *dairy* is generally situate near the milk-house, and fitted up with two *set-pans* or *boilers*—a large one for scalding the whey, and a smaller one for heating water. The "cheese presses" and "screw" are kept within this room, and the operation of cheese-making is here carried on. Some farm-houses are not provided with a *dairy*, and the cheese is then made in the *kitchen*—this is commonly the case on small farms. The "salting and drying house" (often one and the same room), if conveniently situated, adjoins the dairy. The cheese is placed here on stone or wooden benches, salted *externally*, and is afterwards left so as to dry gradually before being removed to the cheese-room. By some dairy-maids this external salting is dispensed with, and the room is then of course only used for drying. These offices are all on the ground-floor. In some cases the cheese-room is over the dairy, in others over the kitchen, or some other room wherein a fire is usually kept, and sometimes, though rarely, over the *cow-houses* or *stables*. Light and air are invariably excluded, either by a curtain or shutters [one reason, amongst others, assigned for this (universal) practice, is its tendency to prevent the mischievous effects of the fly]. The floor is either of plaster (gypsum) or boards, but more commonly the latter; some of the larger cheese-rooms are warmed by stoves, or hot air, and occasionally, though rarely, by fire-places in the room itself. The small cheese-rooms are seldom supplied with artificial heat, except what is gained from the rooms below. Some cheese-rooms are occasionally found to be in the summer time too warm, in which case the cheese has to be removed for a time to a cooler part of the house. This is more generally necessary where the building is slated, and exposed to the noon-day sun; but it is seldom or never experienced where the roof is of thatch. The size of these offices is of course regulated by the extent of the farm; where 30 cows are kept I find them nearly as follows:—

	Yds.	Yds.		Sqr. Yds.
Milk-house	6 by	3	or about	18
Dairy.....	6 by	5	„	30
Salting and drying-house ..	4 by	5	„	20
Cheese-room over dairy and drying-house	10 by	5 (or 8 by 6),	„	50

Process of Cheese-making.—As the first process—namely, that of extracting the whey and salting—occupies, according to circumstances, from five to seven hours, it is found most convenient to commence it in the morning. This being the case, the evening's milk has to be kept all night in the milk-house. In the morning, the cream having been skimmed off, a portion of this milk is warmed. This is done in a circular flat-bottomed brass or tin pan, floated in the boiler, the water of which has been previously heated for that purpose: the size of this pan is about 20 inches in diameter and 8 inches deep. The quantity to be warmed depends upon the state of the weather; for the first two or three months of the season (say March, April, and May) it is not unusual to heat as much as half the evening's milk to a temperature of 100° Fahrenheit, and this heat is rarely exceeded, excepting by those dairymaids who wish to save themselves trouble in the after process. The "cheese-tub," which is similar to a brewing-tub, having been placed in readiness in the dairy, the cold milk is now put in and the warm added. Supposing the temperature of the cold milk to be about 50 deg., and the warm 100 deg., and they were in equal proportions, the heat after mixing would be 75 deg., or something less; but in warm weather it will be sufficient if it reaches 70 deg. I have known instances of good cheese being made in summer without warming any portion of the evening's milk, indeed such now is becoming the general practice. In very warm weather some dairy-maids think it necessary to reduce even the temperature of the morning's milk. The *cream*, which is diluted either in about double its quantity of warm or new milk, or by being exposed to the heat of the boiler in the same way as the milk, is next put in. I have before stated that it is customary to retain a small part of the cream for butter: when this is the case, it is considered best to skim it off the whole surface of the cream before diluting, as by that means the froth and bubbles, which are supposed to be prejudicial to the cheese, will, for the most part, be taken off. This leads me to the conclusion that *fixed air*, if it gets mixed in the curd, has been found to be detrimental. Since warming of fluids has a tendency to dispel this fixed air, it is perhaps worthy of consideration whether it would not be better to warm the *whole* of the evening's milk to the required temperature, rather than heating a *part* of it so high as 100 deg. The process adopted with the evening's milk, as above bed, is generally finished previous to the time of milking morning; but if not, the dairy-maid stops and completes

it before the *new* milk is brought in from the cows. This new or morning's milk is then added by passing it through a *sieve* placed upon the "cheese-ladder" over the cheese-tub. When the whole is thus collected, some few bubbles are invariably found floating on the surface; these are skimmed off and passed through the sieve to break them.

One of the most important points now to be attended to is the heat of the milk preparatory to coagulation, as the milk, if at a proper temperature, should now be ready to "set together," that is, to receive the rennet. This heat is rarely tested by any other thermometer than that of the dairymaid's hand; some may, and I have no doubt do, determine it pretty correctly, but cannot always.

In consequence of the changes in the weather it is difficult even for an experienced dairymaid to know at all times what proportion of the evening's milk should be warmed; she is therefore cautious not to warm too much, until the morning's milk is added and the consequent heat ascertained. If it be deemed too cool, a little of the evening's milk which has been reserved is then warmed, so as to produce the heat required; but when none has been reserved, the necessary quantity taken from the tub after the admixture of the two milkings is warmed for that purpose. Little is known amongst the farmers or dairymaids as to the *precise heat* which is best. I have seldom heard the subject named, except by a vague comparison that such and such dairies were made *colder* or *warmer* than others. I am acquainted with some farmers whose wives are said to have a peculiar method of their own, and who, I believe obtain a high price for their cheese in the Manchester market, chiefly from the tendency of the cheese to green mould. I know little of the system which these parties adopt, but I understand they make their cheese "cold"—that is, set the milk together at a low temperature; and I am also inclined to think they use less salt than others.

I ought, perhaps, to state that I have tasted some of these cheeses, and find them generally very good, fair toasters, and without colouring: but in some I have detected a slight sourness: from this cause, or, what is more probable, from too little salt being used, the cheese will not keep long before decomposition takes place. To the farmer this would only be of consequence in the event of his not being able to sell the article at the time he wished. In the dairies where I have been permitted to take observations, the lowest heat of setting the milk together was 77 deg. I am disposed to think those who make a so-called *cold cheese* do not adopt much lower temperatures, even in summer, than 74 deg. or 75 deg.; since a much longer time would be occupied in gathering and compacting the curd, and considerable risk incurred of having what is termed a *sour cheese*.

The evening's milk in the tub being at or about 75 deg., as before stated, and the milk which is brought from the cows 90 deg. or 95 deg., the temperature of the whole is then found to be

somewhere between 80 deg. and 85 deg.; and I am of opinion that the heat at which milk ought to be and is commonly coagulated ranges between those two temperatures*

When *colouring* is used, which is not so extensively the case as formerly, it is put into the milk immediately before the rennet. (See for rennet, *post* and p. 109). The *quantity* of colouring is in some degree regulated by the quality of the milk: if a considerable portion of the cream of the evening's milk has been taken out for making butter, a greater quantity of this colouring matter will be required to give the cheese that appearance which is found necessary to please the *eye* of the consumer, and particularly of those residing in London or at a distance. *Annatto* (or rather a colouring matter which *goes by that name*) is the article used; 1 lb. of it for each ton of cheese is a moderate calculation; this would be after the rate of half an ounce to 75 lbs. The present retail price of the "best *real* Spanish annatto" is 4s. per lb. The colouring is prepared and applied in different ways, but the most common is to take a piece of the requisite size, to fold it in a small bit of linen, and put it in half or a quarter of a pint of warm water the previous night. By this means it gets sufficiently dissolved. When the infusion is poured into the milk, the linen bag containing it is dipped in, and rubbed betwixt the fingers until the colouring is all discharged. The dregs, if any, remain in the bag.

The *rennet*, or *steep* as it is commonly called, is next added. I have already stated in the introduction, that this is an infusion made from the preserved stomach or maw of sucking calves, thence called *maw-skins* or *bag-skins*. To define the quantity of rennet sufficient for coagulating a given quantity of milk is a very difficult matter, as the maw-skins vary so much in quality. When the farmer is laying in a stock for the year, he generally calculates upon a dozen of skins to a ton of cheese, but the skins vary in size (the price when cured is from 6s. to 9s. per dozen). In using them, it is the practice often to cut two skins at once. Three square inches taken from the *bottom* (or strongest part) of one, and one or two inches from the top (or weakest part) of the other, is generally found sufficient for sixty gallons of milk. These two pieces of skin are put into a cup containing about half a pint of luke-warm water, with the addition of a tea-spoon-

* Since writing the above I have met with a farmer in Eddisbury Hundred, who says he used the thermometer during the year 1841 for the first time, and that the heat he uniformly adopted was 84 deg. I also found a thermometer at another dairy near to this, but it was not in use. I was allowed to test the heat of the milk with it, and found it 78 deg.; this was in *June*. The precise heat at which milk ought to be coagulated is a matter of vital importance in cheese-making, and can only be ascertained by a series of careful and judicious experiments made by scientific and practical parties.

ful of salt, some part of the day previous to being used. The water thus impregnated with the maw-skin is passed through the sieve into the milk, but the skin itself is generally, though not always, kept out. The rennet cup is well *scalded* before being used again. I have been told that some farmers make a sufficiently large quantity of rennet to last for several weeks, and find it to answer better than making a small quantity daily. The question is, will it keep *sweet?*

The colouring and rennet having been put in, the milk is well stirred and left to coagulate. It is usual to invert the skimming-dish on the surface of the milk—a practice of doubtful propriety, for this reason, that the curd immediately under it does not attain the same adhesiveness as the other, and is one of the causes of what is commonly called *slip curd*. The tub is now covered up, either with a wooden lid, or with cloths supported by the "cheese ladder;" these assist in preserving the heat of the milk, and protect it from dust and dirt.

The coagulation (or "coming") is generally effected in an hour or an hour-and-a-half. As far as my own observations extend, I am led to think that an average of these two is sufficiently long, if the proper means are used in effecting the formation of the curd: for it is well known that, *cæteris paribus*, the warmer the milk is at the time of setting together, or the stronger the rennet, the sooner will the coagulation take place, but the curd will in consequence be tougher and less in quantity; on the contrary, the cooler the milk, or the weaker the rennet, the longer will the curd be in forming, and the more tender its quality, but its quantity will be greater. By attention to these results the cheesemaker may soon decide when too much or too little rennet has been put in the milk, and correct the quantity the next time. It may be proper here to state that too much rennet has a tendency to impart an unpleasant flavour, or bitterness, to the cheese.

It may generally be expected that the heat of the curd when formed will be four or five degrees less than the milk was when set together; and it is desirable, particularly in cool weather, that this difference should not be greater, otherwise the subsequent labour will be more difficult. To determine exactly when the *curd* is in a fit state for what is called "breaking," requires some practical knowledge; with attention this is soon acquired. The point is generally determined by gently pressing the surface of the milk with the back of the hand, or by lifting up the skimming-dish, beneath which the curd and whey will distinctly appear if the coagulation is complete. Another criterion is the colour of the whey, which should be of a pale green.

The "breaking" and "gathering" of the curd is the next process. This used formerly to be done by means of the hands and skimming-dish (a practice still continued in some dairies); but the *curd-breaker* is now generally made use of for this pur-

pose. It is made of wire-work, in an oval form, and has a tin rim round it about an inch-and-a-half broad. This wire-work cuts the curd, by being passed through it perpendicularly, *very, very* gently at first, and in different directions, so that the whole mass is separated into very small portions. The length of time required for the operation depends upon the quantity of curd: for a 60lb. cheese the operation often takes twenty or twenty-five minutes. After this the curd is left for a quarter of an hour to separate from the whey, and, if the weather be cool, the tub is covered to retain the heat. The curd having separated, which it does by sinking, a portion of the whey at the top is then taken out by the portable brass or tin pan before alluded to, being *pressed* into it, and emptied into the *set-pan*. The curd is then gently broken by the dairy-maid and her assistant passing their hands down to the bottom of the tub, and buoying up a portion of the curd at each time to the surface, or by again using the curd-breaker. The curd having been brought to the top, is easily seized, and separated into smaller portions, and the whey thereby released. This operation takes about half-an-hour. After the expiration of another half-hour (or so soon as the curd is considered sufficiently settled—for there is no saying to five or ten minutes how long each particular interval of rest should be) more whey is taken out, and the curd afterwards drawn as much into one half of the bottom of the tub as its loose texture will admit of.* Upon the curd is then placed a semi-circular board adapted to the size of the tub, with a weight of about 30lb. placed upon it. This board is perforated with holes, about half an inch in diameter, to allow the whey to escape through. The tub is now set three or four inches atilt to drain the whey more readily from the curd, and to admit of its being collected and carried off. The skimming-dish is again required to lade out the whey. The whey, on its way to the set-pan, is passed through a sieve, to collect any curd which may happen to be floating in it. This curd is what is called *slip curd*, which by some is not returned to the tub, for the reason I have before stated. The weight and board are shortly taken off, and such part of the curd as has been squeezed from under them is again collected on one side, and a heavier weight (say 50lb. or 60lb.) applied as before. As the whey escapes from the curd it is laded

* At this stage, it is the practice with some dairymaids, when they suppose the curd is colder or more tender than it ought to be, to return a few gallons of whey after it has been heated over the boiler in the brass pan into the tub again, to assist the discharge of the remaining whey. If, on the contrary, the curd is found warmer than is intended or desirable, which is sometimes the case in hot weather or during thunder, a few gallons of cold water are applied to prevent the curd becoming tough. These inconveniences would, in my opinion, seldom if ever happen if a thermometer was used at first, and the proper heat at that time adhered to.

out. In the course of a quarter of an hour the board is again removed, the curd cut in intersections of six or eight inches apart, to assist the discharge of the whey, and the board, with additional weights (about double the last), again applied. Some dairymaids now add the slip curd. The weights are again increased if it be thought necessary: observing always to *let the pressure which is applied be gradual, and regulated by the degree of compactness of the curd*, for if this is not attended to now, as well as afterwards, a considerable portion of butyraceous matter will be forced out and the cheese of course deteriorated.

The curd is again cut into square pieces, taken out of the cheese-tub and broken a little by the hands as it is passed into the "thrusting-tub." (In some dairies a large-sized cheese-vat, in others a willow basket is substituted for the thrusting-tub.) In this the extraction of the whey is afterwards continued by the application of "the screw," of which there are two or three kinds, but all on the same principle. The old plan of *thrusting*—and from which the *term* is no doubt derived—was by means of a pole four or five yards long, fixed at one end into an upright post, whilst at the other was seated a lusty lad or a man, who kept regularly pressing down the pole upon the curd, the pole acting as a lever. Both poles and men are now almost entirely expelled from the Cheshire dairies; and the *screw* is also likely to be superseded by the "lever press." The advantages of this over the screw are, *that it sinks by its own action with the curd—any degree of pressure required can be applied and gradually increased, and less attention is necessary*; whereas the pressure from the screw is sudden and uncertain, and having no self-action, requires the dairymaid's assistance every five or ten minutes to render it effectual.

The "thrusting-tub," in which the curd has now to be pressed, is round, and is perforated with holes at the sides and bottom for the whey to escape through. Before the curd is put in, a "cheese-cloth" of the coarsest kind, about one-and-a-half yard long and a yard wide (or of dimensions sufficient to contain the curd), is placed in it.* In this the curd, after being broken, as before stated, is enveloped, and a "sinker," or strong circular board, which fits the inside of the tub, placed on it. Upon this the screw (or lever press, if used) is let down, and the power gradually applied.

To assist still further the discharge of the whey, long iron skewers are introduced through the perforations in the tub, with their points directed upwards, so that when the skewers are withdrawn there is a drain made for the whey to follow. These skewers do not remain in more than five or ten minutes; the

* *Cheese-cloths* are *linen*, of a rather closer texture than canvas, and made for the purpose. The coarse kind are sometimes termed *screw-cloths*.

pressure is continued a little longer. The curd is now cut *through*, in intersections of two or three inches apart, with a large *dull* knife, so as not to injure the cheese-cloth, and the edge or corner of the curd is cut off all round, and placed in the centre. After this the pressure is again applied, and gradually increased, and the skewers introduced and withdrawn as before, after the lapse of about fifteen or twenty minutes. The curd is then taken completely out of the tub, cut into four or five pieces, and each piece broken separately with the hands to about the size of two or three inches square. A clean dry cloth is made use of, the curd folded in it, and again pressed and skewered. These operations are repeated until the whey is sufficiently extracted to admit of the curd being *salted*, which is the next part of the process.

If the milk is set together at six o'clock, and the coagulation takes place in an hour and a quarter, the breaking, gathering, and preparation for salting is generally accomplished by eleven or twelve o'clock.

This is merely mentioned as some guide to the *new beginner*, who may not be able to judge from the state of the curd when it is fit for salting. I may here observe that it is the practice in some dairies to salt the curd, whilst, in my opinion, there is *too much whey in it*.

The *quantity of salt* used is regulated by some old custom, or by the fancy or taste of the dairymaid, and with about as good a chance of correctness as that with which she regulates the temperature of the milk by the touch. That clever and experienced persons may determine the proper quantity of salt in this way tolerably well, I admit; but there are many others who *fall into error*, and all *for want of some fixed rule*. If there be a certain proportion of salt which would answer the purpose best, which there doubtless is, why not ascertain and adopt it? Since writing the above I have learnt that a farmer in South Cheshire, well known for his introduction of improvements in agriculture, has commenced the system of weighing his curd previous to salting it, and he says he uses salt in the proportion of 1 lb. to 42 lbs. of curd. He also informs me he sets his milk together by a thermometer, and at a temperature of 76° or 77°. —May, 1845.

It has generally been considered that a gallon of milk (supposing little or no cream has been taken from it) will produce upon an average of the season 1 lb. of saleable cheese; that is, when the cheese is four or five months old. In autumn there is always more curd from the same quantity of milk than at any other part of the season.

During wet weather there will sometimes be more milk than usual, though not a proportionately greater quantity of curd. An experienced dairymaid soon detects these different results, and makes allowances accordingly. I have met with no dairy-

maid who regularly weighs the salt; but a highly-respectable farmer, whose wife makes a first-rate cheese, has given me the weight used in his dairy, as near as the same can be *computed*. It is as follows:—

	lb.	lb. oz.	
In March and April their cheeses average about	30 and about	0 10	of salt is used.
In May, June, and July .	70 „	2 0	„
In August	60 „	1 12	„
In September . . .	50 „	1 4	„
In October and November	30 „	0 10	„

In the above instance it will be seen that more in proportion was used in summer than at other times, and that the average is 1lb. of salt for 40lbs. of dried cheese (or say forty gallons of milk.)

I was favoured with an account from another dairy in which, to oblige me, the salt *for once* was weighed. For a cheese which weighed 46lbs. a few days after making (say 42lbs. at four months old) 1lb. 1oz. was used. This is also after the rate of 1lb. of salt for 40lbs. of dried cheese, and was said to be the quantity uniformly used throughout the year in this dairy, which consisted of about forty cows.

A third account is from a dairy of sixteen cows: the quantity of salt used was generally about 1lb. for 45lbs. of cheese; but the dairymaid made a trial last year with one cheese, using only three-quarters of a pound. The cheese was made at the beginning of June, and when weighed in the middle of September was 42lbs. This cheese was admitted to be better than the others in the same dairy.

The salt termed the "middle grained" is the kind generally used; but some use "fine." Before applying it the curd is cut into three or four equal sized pieces, and each of these is broken into smaller pieces by hand, or is passed *once* through the curd-mill. The salt is then scattered over it and the "breaking" continued either by the hands, the curd-mill, or both, until the salt is well intermixed and the curd perfectly crumbled. Each portion as it is broken is put into the cheese-vat, in which has first been placed a clean and rather finer cloth than was used for the previous process, and the curd is compacted as much with the hands as possible. To admit of the curd being properly pressed, it is necessary to put it into such a vat as it will *overfill* by at least two inches. It is also rounded up a little in the middle. The cloth is then brought over it and tucked in at the edges of the vat with a small wooden knife or other dull-edged instrument. In order to support the outside of that part of the curd which is above the vat, and to keep it in proper form when the press is applied, a tin or zinc hoop or "fillet," the edges of which are rounded off so as not to cut the cloth, and the ends lapping over and unattached, so that the same fillet will do for

different sizes of cheese, is introduced round the inside of the top of the vat. The "fillet" thus placed sinks with the curd, and having small perforations in it, the emission of the whey is effected through it, as through the perforations of the vat. Since it has become the fashion to make Cheshire cheeses *thicker* than they used to be, it is no unusual thing to see fillets six or eight inches broad.

The vat is now again placed under the screw or lever press, and the skewering is also continued. The pressure is increased at intervals, and the skewers inserted in fresh places to accelerate as much as possible the discharge of the remaining whey or "*thrustings*," as it is now termed.

In the course of an hour from the time of salting the curd is taken from under the screw or lever press and out of the vat, for the purpose of being turned upside down, which is done on a table. In the first place, the angles of that side which was topmost in the vat are cut off; a circular piece, two or three inches deep, is often also scooped out of the centre, and both are broken small with the hands and rounded up in the middle. The cloth being drawn over the curd, the vat is then turned down upon it, and re-turning the vat with the curd in it, the other angles and centre part of the curd are broken in a similar manner: after which the tin fillet is put on, and the screwing and pressing is continued as before for about half an hour or an hour. It will, probably, be two or three o'clock in the afternoon before the curd (or cheese, as it may now be termed) *is got under the press*; that is, when it is removed from the screw to the stone press: but where the lever press is used instead of the screw, which, I think, might always be advantageously done, all the change that will now be required is a little more weight at the end of the lever.

Before turning the cheese for the purpose of placing it under the press, it is usual to prick it perpendicularly down with a skewer in several places, for the purpose of making drains for the whey, after having been so turned. A clean cloth is applied, and where the lever press is not used the cheese is put under one of the lightest of the other kind. A pressure of six, eight, or ten cwt., according to the size of the cheese, will be sufficient. This is generally accomplished by about two or three o'clock in the afternoon. Smaller skewers are now used, and remain (by removing them occasionally into fresh places) until about four o'clock: they are then withdrawn, but the cheese remains half an hour longer undisturbed, to allow the whey to drain from it. It is then, or some time in the evening, turned, a clean cloth is put over it, and the pressing continued. If the lever press be used, the weight may be a little increased.

On the *second day* the cheese is generally turned twice or three times; it is also skewered, and clean cloths are used each

time of turning. I would observe here, that if any of the cloths are used again before they have been washed and dried in the open air, great care should be taken that they be well *scalded*. The presses used for at least the two first days, and, if possible, during the whole process, should be situate in the dairy, kitchen, or some other moderately *warm place*, otherwise the whey will be longer in discharging, and more liable on that account, from the acidity which it soon acquires, to injure the flavour of the cheese. Another advantage of the lever press is that in cold weather it may be easily moved to a sufficiently warm place, which cannot be the case with the common presses. These common presses are chiefly made of one square block of stone fixed in a wooden frame, but are also made of wooden boxes filled with slag or other heavy material. They are generally fixed by the walls of the dairy, for the purpose of being stayed to them, and being there most out of the way; when there is not room in the dairy or kitchen, they are placed in the salting room or pantry, which latter places are often much too cold for the purpose, as the whey seldom gets thoroughly extracted when the presses are in cold situations.

On the *third day*, the cheese is again turned once or twice, but ought not to require any skewering. The heaviest press is now had recourse to, and for a cheese of 60 lbs. or 70 lbs. weight about 30 *cwt.* will be pressure sufficient; but some dairymaids apply as much as two tons, their heaviest press being that weight. A cheese-press of this weight, made of a block of red freestone, would be 3 ft. 2 in. long, 2 ft. 8 in. wide, and 3 ft. 2 in. high.

On the *fourth day*, it is usual in most dairies to discontinue the pressing, but in others it is continued for a day or two longer.

The cheese is then removed to what is called

The Salting and Drying Room.—Sometimes these are distinct apartments, but more generally one room suffices for both purposes. The salt can now, of course, be only applied *externally;* and the good, if any, effected is to harden the coat of the cheese. The cheese I have before alluded to, as having been made with three-quarters of a pound of salt, and which *was much above an average in quality*, was removed. as on experiment, *direct from the press to the cheese-room.* I am inclined to think this is the better system, or at least that a great deal of the present labour of the salting-house might be dispensed with.

It is, however, only right to state that in most of the dairies of this county the practice of *external salting* still obtains. I will therefore describe the process usually adopted.

The cheese is taken out of the vat, and a strong bandage called a "fillet," about 2 inches broad, and long enough to go three times round the cheese, is used. As this bandage is put on, salt is applied underneath it, to the coat of the cheese. The

bandage is fastened with strong pins, the cheese placed on stone or wooden shelves or benches, and salt spread on the top to within an inch or two of the edges. The cheese is turned daily, and fresh salt and a clean bandage applied. In some few dairies it is the practice, before the salting above described, to half immerse the cheese for two or three days in strong brine kept in a shallow tub for that purpose. The salting process above described is continued for various periods: by some for five or six days, by others as long as three weeks. I will give the rule followed by the farmer who furnished me with the particulars of his salting of the curd. It is as follows:—

From the beginning of the season (about March) to the time of the cows being turned out to grass (12th May), the cheese remains in salt four days; from thence to the end of July, ten days; in August, eight days; September, six days; and the rest of the season, four days.

It is obvious, from the practice in this dairy, that it is considered necessary for the cheese to remain in salt longer in the middle of summer than at other seasons.

After this salting, the cheese is well wiped or washed, has a clean bandage put round it, and continues in the same room, or an adjoining one, on wooden shelves, for the purpose of being *dried*. It is turned once a day, and remains until it is considered sufficiently dry for being removed to the *cheese-room*. The length of time for keeping cheese in the "drying-house" varies from seven to twenty days; and is regulated by the temperature of the weather, or the *cheese-room* to which it has to be next removed. In hot weather, and especially if the cheese-room is exposed to the heat of the noon-day sun, the change from a *too cold drying-house* (as many often are, except perhaps in the middle of summer) to a too hot cheese-room, is calculated to cause *cracks* in the cheese, which said cracks have from time to time to be filled up by the application of bacon-fat, or whey-butter, otherwise mites would soon be generated, and the appearance of the cheese detracted from. To prevent this cracking as much as possible, the salting and drying houses have rarely if ever the windows opened, and drafts or currents of air are thereby prevented. This precaution is also adopted in the cheese-room; and, in addition, the light is excluded either by a shutter or *blind*, as I have before stated.

The cheese I have before alluded to as having been made without any *external salting*, as an experiment, and which *was taken direct from the cheese-press to the cheese-room*, was made in the beginning of June, and at the end of September was ready for the *market*. The quality of the cheese was better than that made in the ordinary way, and all the labour of the salting and drying-house was saved. My own impression is, as I have already hinted, that the drying-rooms are often *too cold*; and that if it is found to be desirable, as perhaps it may be in some

dairies, to continue the use of such drying-rooms, the heat should be kept as near as possible at from 50° to 55°. In concluding my remarks on this room, I must not omit to observe that it is necessary the cheeses should remain *bandaged*, in order to prevent their bulging, and also that they should be turned over once a day. If one cheese be made daily, one will, consequently —in the course of a certain time after the season of cheese-making commences—have to be removed every day to the *cheese-room*. When taken to this room, the situation of which I have before described, it is usual to scrape and clean the coat of the cheese, and to place it, in the first instance, in the coolest part of the room, often for a few weeks upon shelves or benches which are cooler than the floor, subsequently upon the coolest part of the floor, and ultimately upon the warmest part. It is usual to continue the bandage or "fillet" for several weeks after the cheese gets into this room, and indeed in some dairies until it is sold. It is also usual to turn the cheeses, and wipe them with a cloth daily, for at least three or four months, and every alternate day afterwards; and when there are any symptoms of cracking, bacon-fat, hogs'-lard, or some other fatty substance, is applied. The floor of the cheese-room is generally covered with dried rushes, or a coarse grass resembling rushes, called "sniddle," or wheat-straw. The floor should be *level*, otherwise the cheeses will not be kept easily in shape; and should be well washed with hot water and soft soap about twice a-year. The temperature of the cheese-room should, when attainable, range between 60° and 65°. When this is the case, the "first make" will generally be ready for the factor by September or October, and the "latter make" by December or January; but in consequence of many rooms being badly situated and imperfectly heated, the farmer very often does not get his cheese into the market until two or three months after these respective periods. The object gained in having the cheese-room about the temperature I have named is three-fold: the perfect fermentation and ripening of the cheese, the reduction of labour, and the quicker return of *profit*.

THE SCALDING OF THE WHEY, AND THE MAKING OF WHEY-BUTTER.

This process is carried on simultaneously with the making of the cheese. The whey which comes from the curd previous to its being salted is called the *green whey*, and that which is extracted afterwards the *thrustings* or white whey. The latter are more or less impregnated with salt. As soon as the principal part of the green whey is collected in the *set-pan*, a fire is lighted under it of Cannel coal, crop-wood, or other quick burning fuel. The remainder of the green whey is added after the fire is lighted. It is usual to skim off any small particles of curd which float on the whey, and give them to the poultry. Whilst

the whey is heating it is necessary that it should be frequently stirred, or it will be liable to burn to the bottom of the pan. When it has attained a heat of about 160 degs. or 170 degs., if any whey is wanted for the family it is then taken out. When the whey has reached the heat of 180 degs. it is in a fit state for *breaking*. This may be effected by any simple acid, but it is customary here to use sour buttermilk, and with it the *thrustings* of the previous day. The quantity of buttermilk necessary may be easily ascertained. I have only noted what was used in one instance, which was one pint of buttermilk and 2 quarts of thrustings (which had been mixed the day previous to being used, and kept in a tolerably warm place to increase the acidity) to 22 gallons of whey. The *breaking* by this method, which is almost instantaneous, has the effect of causing all the creamy matter to rise to the surface, from which it is regularly skimmed off, and put into a cream-mug. The last skimmings are termed *fleetings*, and are generally reserved for the nse of the servants. It is necessary, after the *breakings* are put in, to check or withdraw the fire, to prevent the whey from boiling. The refuse whey, after the cream is skimmed off, is laded out of the pan for the use of the pigs; and it is generally conveyed by a spout fixed above the pan, which leads to a cistern or tub in which the pig-meat is kept.

The making of butter from *whey-cream* varies very little from the process of making butter from the cream of milk. The cream is kept for three or four days, or until it has become clotted (provincially termed *calved*). Those who make the best whey-butter have a spigot and faucet to each of their cream-mugs to let off the whey, which in the course of a few hours settles at the bottom, and which, if allowed to remain, imparts a rank flavour to the cream, and consequently to the butter. The temperature of the cream, when put into the churn, is generally ascertained by the hand; but if a thermometer be used, the heat which I would recommend is 60 degs., having found that the best. If it be much *higher* than this, the butter may be expected not only to be soft, but inferior both in quantity and quality; and if much *lower*, the operation of churning will be prolonged, and indeed tedious. At this heat the time it is churning will probably be about an hour and a half. It will perhaps be necessary in cold weather to put hot water into the churn, and in warm weather to put in cold water, in order to attain this desirable object as to heat.

From 100 gallons of milk there will not be less than 90 of whey, which should yield from 10 to 12 gallons of cream, or 3¼ to 4 lbs. of butter. The quantity of whey-butter per cow is about half a pound per week, taking the season through; but with that small portion of cream of the evening's milk (to which I have alluded at p. 96) added, the farmer often churns as much as three-quarters of a pound of butter per cow per week, or from

20 to 25 lbs. per annum: 1 lb. of salt is sufficient for curing 37 lbs. of butter, if for present use.

CHEESE-COLOURING.

This ingredient is or should be *annatto* (or *annotto*), the produce of the *Bixa orellana* of Linnæus. It is, I believe, chiefly imported from the West India Islands, and used for dyeing. The colouring chiefly used in cheese-making is *prepared* by manufacturers in this country for the purpose. It gives the cheese that amber or cream-like appearance which is unfortunately required in order to *please* or *deceive* the eye of the London consumer. For the Manchester and Liverpool markets, and for *home* consumption, the Cheshire farmer rarely uses it in his cheese-making, as it is well known it does not improve, but if an inferior article is bought, and especially if much be used, it may deteriorate the flavour very much.

"A WORD OF ADVICE TO THE CHEESE DAIRYMAID.

"Let your rennet or steep be put into your milk of a temperate heat or warmness. After the curd is formed, do not let any part of it be starved, or get any colder than your own hand.

"All dairymaids that would have real fine-flavoured cheese would do well to thrust it with their hands, that there are no cold draughts from doors upon their curd, but keep it gradually warm, but not to scald it neither with water, whey, nor burning vats. Have your first press not too heavy, and in as moderate a warm place as you can possibly place it; study a warm salting-room; use neither flags nor slates for your cheese to lie on, but good planks; your drying-room to be moderately warm, and also cheese-room; cold damp rooms, flags, or slates, will spoil the handiwork of the best dairymaids; you should never suffer your cheese to be starved, or get into a cold damp state, as it very materially hurts the flavour.

"Good calf skins, or calves' bags, as are invariably made use of, are of serious consequence to the flavour and the coming of the cheese."

A RECIPE FOR CURING THE MAW-SKINS.

Procure the skins fresh from the butcher the year previous to their being wanted; clean out the chyly matter, and every other apparent impurity; the inside is then turned outward on a table, and salted; the skins are then laid one upon another, with a layer of salt between each, in a deep earthenware vessel similar to a cream-mug; they are then covered over with salt, and have a lid of slate or flag placed on the top. They are taken out as wanted, about a month previous to being used, and the brine drained from them. They are then spread on a table, and fine salt is powdered on each side. In this state they are rolled with a paste roller, distended with a splint of wood, and hung up to dry.

STILTON CHEESE.

The cheese which is generally known by the name of Stilton is made in Leicestershire, according to the *Agricultural Report* of that county, in the following manner:—The night's cream is put into the morning's new milk with the rennet; but when the curd is come it is not broken, as is done with other cheeses, but is taken out with a soil-dish altogether, and placed in a sieve to drain gradually; and, as it drains, it is pressed, till it becomes firm and dry; being then placed in a wooden hoop, and afterwards kept dry on boards, it is turned frequently, with cloth binders round it, which are tightened as occasion requires. Cream cheese of good quality is likewise made, in some districts, by adding the cream of one meal's milk to the milk which is immediately taken from the cow. This, after being made and pressed gently two or three times, and carefully turned for a day or two, is fit for use.

CREAM CHEESE

Is readily made; it is little else than thick, sweet cream, dried by being put into a small cheese vat of about an inch and a-half in depth, perforated with small holes at the bottom to allow any portion of the milk which may be mixed with it to escape. It is also covered with rushes, or the long grass of the Indian corn, so disposed as to admit of its being turned without being handled. It is thus kept in warm situations to sweat and ripen; for if once penetrated by frost, or even chilled, much of its mellow sweetness is lost, and it becomes insipid (*British Husbandry*, vol. ii., p. 435.)

HEAVING OF CHEESE.

This is a very common complaint in some districts and dairies. It is believed to arise from the fermentation in the whey left in the cheese. In some dairies the heaving of the cheese can hardly be prevented: it perhaps arises from its being difficult in those places to get such a curd as will allow the whey to be well pressed from it; there is always, in fact, great danger of heaving if the whey is not well pressed out.

BREWERS' GRAINS.

Brewers' grains are very extensively used in the feeding of milch cows. They consist chiefly of the husk, and other insoluble matters of the corn employed in the operation of brewing. When speaking of the large dairies of the metropolis, Mr. Youatt remarks, "The principal food of the cows in all these is grains; and as the brewing seasons are chiefly in autumn and spring, a stock of grains is generally laid in at those seasons for the rest of the year. The grains are laid up in pits lined with brick-work, set in cement, from ten to twenty feet deep, and of

any convenient size. They are firmly trodden down, and covered with a layer of moist earth eight or nine inches thick, to keep out the rain and frost in winter, and the heat in summer. A cow consumes about a bushel of these grains daily, the cost of which is from fourpence to fivepence, exclusive of carriage and preservation. The grains are, if possible, thrown into the pit while warm and in a state of fermentation, and they soon turn sour; but they are not liked the worse by cattle on that account: and the air being perfectly excluded, the fermentation cannot run on to putrefaction. The dairy-men say that the slow and slight degree of fermentation which goes on tends to the greater development of the saccharine and nutritive principle, and they will have as large a stock on hand as they can afford, and not open the pits till they are compelled. It is not uncommon for two years to pass before a pit of grains is touched; and it is said that some have lain nine years, and been perfectly good at the expiration of that period. The grains from a large ale brewery are the most nourishing; those from the porter brewers not so good; and those from the little ale brewers hardly worth having. It is found by the distillers, that rough clover chaff mixed with grains and wash, will fatten to any extent (*On Cattle*, pp. 255-264, *Farmer's Encyclopædia*).

The brewers' grains or "draff" of Edinburgh has been examined by Professor J. F. Johnston (*Trans. High. Soc.*, 1847, p. 582). In 100 parts he found—

Water	75·85
Gum	1·06
Other organic matter, chiefly husk	1·28
Ditto, containing nitrogen	0·62
Inorganic matter or ash	1·19
	100

The husk, he adds, is not wholly insoluble in the stomach of a cow, nor without considerable nutritive power. There is more nutritive matter in brewers' than in distillers' grains; a bushel of grains weighs about 46 lbs. Cows do very well on grains mixed with turnips. Mr. Caird, of Baldoon, near Wigton, fed a large dairy stock for six or seven months with the following food daily, each cow (*Ibid.*):—

½ bushel of grains,
22 lbs. of turnips,

with the usual fodder. The milk and butter were well tested. The milk from grains is commonly copious in amount, but poor in quality.

THE ACTION OF MILK AND ITS PRODUCTS ON THE HUMAN STOMACH.

Milk, and the substances which it contains, are of the number of the very few animal substances which mankind consume in an

uncooked state. It is, perhaps, to this fact that their very varying action on the human stomach may be in some degree attributed. The following observations of Dr. W. H. Robertson may be found useful (*On Diet and Regimen*, vol. i. p. 121).

Milk seems of all kind of food to be the most natural. It does not agree with the stomachs of most people, its use being often attended with the inconvenience of constipating the bowels, and this is less likely to happen if the milk is thickened with flour or oatmeal; this prevents its curdling in large masses by the action of the gastric juice of the stomach.

Skimmed Milk, deprived as it is of the greater part of the cream, is more easily digested than unskimmed milk. Being only deprived of the oleaginous matter, and still containing the sugar and the casein, skimmed milk is not so much less nutritious than unskimmed milk as has been commonly supposed.

Boiled Milk.—It is probably quite true that in most cases the digestibility of milk is increased by boiling; but, admitting this to be the general rule, there will be found to be many exceptions to it.

Milk Diet.—What is meant by a milk diet may be illustrated from the diet table of the Middlesex Public Hospital. The following is the daily milk diet of that establishment:—

12 oz. bread, 1 pint of milk, daily, for breakfast.

½ pint of milk, with rice pudding 4 days, and with batter pudding 3 days ..... } for dinner.

½ pint of milk, or one pint of gruel, for supper.

Cream is, of course, much less digestible than milk.

Curd is less easily digested than cream, and is much less easily digested than whey, or than skimmed or unskimmed milk. Curd is, however, more easily digested than butter.

Whey, which is the remainder when the curd has been separated from the milk, is usually an easily digested and grateful beverage. It still contains much of the saccharine matter of milk; but the greater part of the oleaginous matter and most of the casein of the milk are separated from it.

Sugar of Milk is obtained from whey by evaporation, to the consistence of honey, and clarification. It presents crystals of brilliant whiteness.

Butter Milk, which is sometimes looked upon as little else than whey, is, however, very different in its nature and composition. It contains a greater portion of the casein (curd) and the saccharine matter of the milk, the oily matter being in great part separated. It rapidly undergoes the acesant fermentation. In any condition, however, it is a very nutritious article of diet, and is duly appreciated as such by the peasantry in Scotland, and the northern counties of England.

Butter is admitted on all hands to be irritating to the stomach of the dyspeptic, and to be with difficulty digested. If eaten at all by such persons it should be used sparingly, and cold.

Melted butter, whether in toasts or in sauces, should be banished from the table of every valetudinarian. The digestibility of butter depends, moreover, very much on its freshness and quality. The less recently it has been made the less easily is it digested: the less carefully it is separated from the butter milk the more apt it is to disagree with the stomach. A cow fed on fresh herbage yields a better and more easily digested butter than the animal which is stall-fed; and this is still more the case if the comparison be made with butter from a cow fed with oil-cake, and strong or rank food. Salt butter, however carefully made and preserved, if kept for some time, is necessarily much less easily digested than fresh butter of good quality. The addition of a certain quantity of salt to butter at the time of eating it promotes, however, its digestion, as in the case of the other oleaginous articles of food.

Cheese or casein, dried, and having undergone some chemical change in the year or two allotted to what is called its *ripening*, is generally very difficult of digestion. The comparative impunity with which many persons can eat toasted cheese may be partly attributed to the mustard &c. usually taken with it, although the *cooking* has much to do with the greater digestibility. Cheese made from cows' milk is more easily digested than that made from goats' milk; and the richer or more oleaginous the cheese the more easily is it digested. There is no doubt that perfectly ripe or well matured cheese is much more digestible than new cheese, whatever may be the opinion regarding the digestibility of decayed cheese. The truth seems to be that, inasmuch as decayed cheese is much more stimulating than ordinary cheese, although in many cases it irritates and disturbs, it often, in other cases, appears to assist a weakened stomach in the digestion of its food.

Cream Cheese, and particularly when used in a state of putrescence, as is commonly the case, is even less digestible than ordinary cheese, especially when the latter is perfectly ripe. When quite fresh, and free from taint or rancidity, and however rich or oleaginous, and by so much more digestible, cream cheese is, nevertheless, mainly composed of case in, and is therefore so much less digestible than butter.

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